REPORT

ON THE

Cawnpore Agricultural Station

IN THE

UNITED PROVINCES

FOR THE YEAR ENDING 30th JUNE, 1906.

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on 24 February, 2020

ADDENDA *and Corrigenda to Report on the Cawnpore Agricultural station in the United Provinces for the year ending 30th June* 1906.

1. *Page* 4.—'Average of 5 years 1890 to 1894' under column of 'Sheep dung at 50 lbs. nitrogen per acre', alternate, *read*, 1184 *for* 1181.
2. *Page* 6.—Year 1896, under 'Residue of cowdung applied in previous years', alternate, *read* 2511 *for* 250.
3. *Page* 6.—Year 1899, under the column of 'Residue of cowdung applied in previous years', standard, *read* 2166 *for* 2156.
4. *Page* 6.—Year 1906. Straw, under column of 'Poudrette at 100 lbs. nitrogen per acre', standard, *read* 3929 *for* 3926.
5. *Page* 7.—Year 1906. Straw, under column of 'Poudrette at 50 lbs. nitrogen per acre'. Standard, *read* 4247 *for* 4126.
6. *Page* 7.—Year 1906. Straw, under column of 'Saltpetre at 25 lbs. nitrogen and bone superphosphate at 10 lbs. nitrogen per acre', standard, *read* 2819 *for* 2825.
7. *Page* 7.—Year 1906. Straw, under column of 'Ashes of 180 mds. of cowdung and saltpetre at 25 lbs. nitrogen per acre', standard, *read* 3215 *for* 3216.
8. *Page* 9.—In line 20th, *add* the word '*consisting*' after '*each*'.
9. *Page* 11.—In line 4th *insert* 'and' before 'cotton'.
10. *Page* 12.—Against field No. 27A/3, under 1905-1906, *read* 778 for 764.
    „ Last line of (2) new potato Solanum Commersonie *read* 'wild state' *for* 'Wild State'.
11. *Page* 15.—American varieties of cotton No. (1); *read* 'Farm' *for* 'Form'.
12. *Page* 23.—Remarks column, *add* the word 'merely' after 'showing'.
13. *Page* 24.—Line 30th, *add* 'on' before 'drainage'.
14. *Page* 24.—Line 34th, *read* 'similar' *for* 'simlar'.
15. *Page* 24.—Line 45th, *read* 'came' *for* 'come'.
16. *Page* 24.—Line 57th, *add* semicolon after 'Ammonia', *read* 'in' *for* 'In', full stop after 'dew' *read* 'And' *for* 'and'.
17. *Page* 24.—Last line of note, *read* 'treated' *for* 'tread'.
18. *Page* 25.—Statement No. 1, against July 1 to 15, under the column of 'Rainfall in inches', *read* 5·67 *for* 15·67, against July 16th to 31st *read* 11·13 *for* 1·13 and against September 16th to 30th, *read* 2·50 *for* ·250.
19. *Page* 26.—Statement No. 2 for 1905-1906, September 1 to 15th, under column of rainfall, *read* 4·20 *for* 420.
20. *Page* 27.—Statement No. 2 for 1904-1905, under the column of 'Nitrogen as ammonia, lbs. per acre', *read* ·171 *for* 1·71.
21. *Page* 27.—Statement No. 2 for 1904-1905, under the column of 'Total nitrogen, lbs. per acre'. *read* 6·84 *for* 684.
22. *Page* 27.—Statement No. 2 for 1904-1905, under the column of 'Total nitrogen, lbs. per acre', *read* 20·36 *for* 2036.
23. *Page* 27.—Statement No. 2 for 1904-1905, under the column of 'Nitrogen as nitrates, lbs. per acre', against total, *read* 56·7085 *for* 567085.
24. *Page* 27.—Statement No. 2 for 1905-1906, under the column of 'Total nitrogen, lbs. per acre', *read* 12·10 *for* 12·12.
25. *Page* 28.—Statement No. 3, against September 1 to 15th, under the column of 'Rainfall in inches, $\frac{1}{1000}$th acre gauge', *read* 3·62 *for* 362.
26. *Page* 28.—Statement No. 3, under the column of 'Difference approximately,' against June 1 to 15th, *read* ·22042 *for* 22·042.
27. *Page* 29.—Seed and soil inoculation, line 15th, *insert* 'merely' before 'made'.
28. *Page* 29.—Seed and soil inoculation, line 18th, *read* 'is' *for* 'does not appear to be'.
29. *Page* 30.—In the statement under the column of 'Seed', *read* 1,742 *for* 1; 742.
30. *Page* 31.—Under columns kharif of 1904-1905 and 1905-1906, against field No. 5, Lobia, *read* 'failed'.
31. *Page* 31.—(*b*) Dofasli rotation, under the column 'treatment' against field No. 13, *read* 'Guar fodder-wheat' *for* 'juar fodder-wheat'.
32. *Page* 34.—Read '*D*' in the blank space above 'chain pump' and '*C*' in the blank space on its right side.
33. *Page* 35.—Statement of acreage outturn, under the column of plot No. 3, against grain of 1906, *read* 2226 *for* 222·6.
34. *Page* 35.—Statement of acreage outturn, under the column of plot No. 1, against straw of 1906, *read* 4735 *for* 4736.

35. *Page* 35.—Statement of acreage outturn, under the column of plot No. 2, against straw of 1906, *read* 3138 *for* 31·38.

36. *Page* 36.—In the statement under the column of 'Outturn per plot', *read* 522 *for* 552½ *and* 8360 *for* 8840 in the next column.

1. *Entomological notes.*—The name 'Heliothis armegera' has been changed to 'chloridea obsoleta' and should be read as such, see page 32.

2. *Composition of drainage waters, &c.*—Add as a foot-note in pages 26 and 27 'Nitrogen as ammonia will not be determined in future, the amount being unimportant.'

3. *Classification of wheats.*—Add as a foot-note in pages 20 to 23. 'This classification is only very tentative as the local wheats of some 20 districts yet remain to be included.'

No. $\frac{17}{A-271}$ of 1906.

From

W. H. MORELAND, Esq., C.I.E., I.C.S.,
Director of Land Records and Agriculture,
United Provinces,

To

The CHIEF SECRETARY to GOVERNMENT,
United Provinces,
Allahabad.

Dated Cawnpore, the 2nd of October 1906.

Sir,

I have the honour to submit the report on the Cawnpore Agricultural Station for the year ending 30th June, 1906. A separate report will be submitted on the experimental work carried out at the Orai Farm. The report has been drawn up by Mr. J. M. Hayman, the Deputy Director, who has been in charge of the experiments at Cawnpore throughout the year.

I have the honour to be,
Sir,
Your most obedient servant,
W. H. MORELAND,
Director.

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Report on the Cawnpore Agricultural Station for the year ending June 30th, 1906.

CHAPTER I.

(a). SITUATION, AREA AND SOIL.

The experimental station is situated close to Rawatpur on the Cawnpore-Achnera Railway and about four and five miles respectively from the East Indian and Oudh and Rohilkhand Railway Stations.

The whole area is irrigable from a distributary of the Ganges canal and consists of 65·7 acres, of which 42·64 acres are under cultivation. The rest is occupied by roads, water courses and farm buildings.

The soil may be accepted as a fair sample of the alluvial loam which occurs over a large portion of the Ganges-Jumna Doab. Though, according to the analyses made in 1882 by the late Mr. S. A. Hill, B.Sc., it contains 78·56 per cent. of insoluble sand, yet owing to the fineness of the particles its physical characters are those of a loam.

The following table gives the composition of five unmanured plots as regards the three dominant agricultural ingredients (*vide* page 54, Agricultural Ledger No. 2 of 1898):—

Composition of the soils of the unmanured plots of the farm.

Name of plot.	Total nitrogen.	Total phosphoric acid.	Available phosphoric acid.	Available potash.
	Per cent.	Per cent.	Per cent.	Per cent.
Rabi standard, No. 11	·024	·085	·021	·012
Kharif standard, No. 13 ...	·016	·053	·022	·007
Alternate series A, No. 13 ...	·017	·088	·030	·007
Alternate series B, No. 11 ...	·023	·071	·014	·012
Green manure series, No. 5 ...	·017	·053	·015	·027
Average	·019	·070	·020	·013

Chemical analysis and practical experience concur in showing that there is no abnormal deficiency of lime or any other plant-food ingredients.

(b). MANURIAL EXPERIMENTS.

(1) Standard and alternate series :—

Name.	Crop.	Number of plots.	Area in acres.	Duration of experiments.
(1) Kharif standard ...	Maize every year ...	13	1·07	Permanent.
(2) Rabi standard ...	Wheat every year ...	13	1·07	
(3) Duplicate or alternate series A.	Maize and wheat alternately.	13	1·07	
(4) Duplicate or alternate series B.	Maize and wheat alternately.	13	1·07	

Maize and wheat.—These four experiments are carried on in four series of 13 plots each, *i. e.* on 52 plots in all. When originally started in 1881 by Mr. J. B. Fuller, there were only 10 plots in each series, and the remaining three plots were subsequently added in 1882 and 1883. Since then there has been no change in the number of plots. One series is cropped every year with maize, another with wheat, and these two are called kharif and rabi standard series respectively. In the other two series known as "alternate series" maize and wheat are grown in rotation in alternate years. Thus the maize crops on the kharif standard plots get every year a fallow of about nine months, while those on the duplicate plots, a fallow of only about two months after the previous crops of wheat is cut. But as regards wheat the rabi standard plots get a fallow of six months against the 13 months on the duplicate plots. Owing to this reason the maize on the standard plots is, as a rule, better than on the duplicate plots, while the wheat on the alternate plots is better, though the difference is less marked and less certain than is the case with maize. The manure applied to one plot of the standard series is also applied to the corresponding plot of the duplicate series. The object of the kharif and rabi standard series is to ascertain the effects and establish the relative values of certain manures on maize and wheat grown year after year on the same land. The object of the alternate series is to some extent to duplicate these trials, and also to study the effects and economy of alternation of maize with wheat.

The scheme of treatment of these plots was changed seven years ago at the instance of the Agricultural Chemist to the Government of India. The old and new schemes, as well as the compositions and quantities of manures applied during the year under report, are given in the next table.

Table showing the old and new schemes of treatment and compositions and quantities of manures.

No. of plot.				Old treatment.	New treatment.	Compositions and quantities of manures applied per acre in 1905-06.			
						Maize.		Wheat.	
Rabi standard.	Alternate B.	Kharif standard.	Alternate A.			Percentage of nitrogen.	Quantity of manure applied.	Percentage of nitrogen.	Quantity of manure applied.
R.3	3	K.3	6	Cattle manure @ 180 mds. per acre.	Cattle manure to supply 100 lbs. nitrogen per acre.	(*a*) ·40 (*b*) ·61	25,000 18,032	·50	20,001
R.4	4	K.1	7	Cattle manure and bone-dust @ 4½ mds. per acre.	Cattle manure to supply 50 lbs. nitrogen per acre.	(*a*) ·40 (*b*) ·61	12,500 9,016	·50	10000·5
R.5	5	K.2	8	Cattle manure and gypsum @ 3 mds. per acre.	No manure.				
R.6	6	K.10	1	Sheep-dung @ 180 mds. per acre.	Sheep-dung to supply 100 lbs. nitrogen per acre.	1·13	8,850	·71	13,516
R.8	8	K.7	10	Sheep-dung and bone-dust @ 4½ mds. per acre.	Sheep-dung to supply 50 lbs. nitrogen per acre.	1·13	4,425	·71	6,758
R.10	10	K.12	12	Sheep-dung and gypsum @ 3 mds. per acre.	Poudrette to supply 50 lbs. nitrogen per acre.	·46	21,739	·31	14,247
R.12	12	K.9	2	Poudrette @ 180 mds. per acre.	Poudrette to supply 100 lbs. nitrogen per acre.	·46	10869·5	·31	7123·5
R.1	1	K.5	4	Saltpetre @ 3 mds. per acre.	Saltpetre to supply 25 lbs. nitrogen per acre.	12·37	202	11·29	221·4
R.2	2	K.11	5	Saltpetre and bone-dust @ 4½ mds. per acre.	Saltpetre to supply 25 lbs. nitrogen per acre. (35 lbs. nitrogen per acre.)	12·37	202	11·29	221·4
					Bone-dust to supply 10 lbs. nitrogen per acre. (35 lbs. nitrogen per acre.)	3·85	260	3·97	145
R.9	9	K.6	11	Saltpetre and bone-superphosphate, each @ 3 mds. per acre.	Saltpetre to supply 25 lbs. (35 lbs. nitrogen per acre.)	12·37	202	11·29	221·4
					Bone-superphosphate 10 lbs. (35 lbs. nitrogen per acre.)	2·88	347	2·69	351
R.7	7	K.4	9	Ashes of 180 mds. of cow-dung per acre.	Ashes of 180 mds. of cow-dung per acre.	·0041	5,999	·015	6,380
R.13	13	K.8	3	Ashes and saltpetre @ 3 mds. per acre.	Ashes and saltpetre to supply 25 lbs. nitrogen per acre ...	·0041 12·37	5,999 200	·015 11·29	6,380 212·9
R.11	11	K.13	13	Unmanured ...	Unmanured ...	...	...	...	...

NOTE.—(*a*) applied to the plots of K and (*b*) to alternate B in maize.

Maize.—The two series bearing maize were treated as follows :—

The standard series.—Ploughed four times, subsoiled once, cultivated with Planet Jr. Cultivator three times, *bakharing* once, and levelled with the patela six times. The alternate series ploughed five times, subsoiled once, cultivated with the planet Jr. Cultivator three times and levelled with the patela, eight times.

The manures were applied at one time in July, except saltpetre, which was applied as a top dressing in two instalments on the 12th and 25th of August. Seed was dibbled, first on 10th and 11th July and second on the 25th of July 1906, in holes two feet by one foot apart from each other at the rate of three to four seeds to the hole to guard against contingencies of uneven germination; the rate of seed coming to about 24 lbs. per acre. When the plants were about a week old the crop was thinned and blanks filled in, weeded, hoed and earthed up twice.

The crop sown for the first time was damaged by heavy rain just after sowing and so the crops were ploughed in and resown. The outturns of both the series are given in the following table.

In previous years the maize straw has been allowed to dry and then weighed—a not very satisfactory plan, such straw being liable to vary considerably in weight according to the amount of moisture in the air at the time, facilities for analysing the straw for moisture having occurred by increase of staff. The straw has this year been weighed at time of cutting and moisture ascertained as per footnote.

Acreage outturns (in lbs.) of dry maize

Plot area.	Year.	Cow-dung at 100 lbs. nitrogen per acre.		Cow-dung at 50 lbs. nitrogen per acre.		Residue of cow-dung applied in previous years.		Sheep-dung at 100 lbs. nitrogen per acre.		Sheep-dung at 50 lbs. nitrogen per acre.		Poudrette at 100 lbs. nitrogen per acre.	
		Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.
Each plot is equal to 400 square yards.	* Average of five years, 1883 to 1886 and 1889.	1,211	1,119	1,442	1,114	1,261	1,006	876	1,003	1,285	880	1,255	1,282
	Average of five years, 1890 to 1894.	996	744	1,303	906	1,471	906	1,330	1,483	1,529	1,181	1,096	1,528
	1895 ...	2,018	1,004	1,900	1,110	2,105	1,140	2,668	1,189	2,344	1,186	1,945	2,027
	1896 ...	2,541	1,156	1,700	1,385	1,706	1,210	2,813	1,706	2,378	1,809	2,148	1,428
	1897 ...	3,158	2,989	3,243	1,422	3,424	2,452	3,733	1,972	3,025	3,633	3,527	1,794
	1898 ...	1,609	1,343	2,105	1,779	2,226	1,682	2,093	2,009	1,634	1,888	2,323	1,984
	1899 ...	1,634	1,701	2,136	1,331	2,202	1,579	2,393	1,246	2,707	1,516	2,426	2,490
	Average of five years, 1895 to 1899.	2,192	1,639	2,217	1,405	2,333	1,613	2,740	1,624	2,418	2,006	2,474	1,945
	1900 ...	2,698	2,420	3,064	2,641	3,167	2,426	2,989	2,605	3,228	2,559	2,940	2,892
	1901 ...	2,538	2,417	2,368	2,017	2,704	1,833	2,468	2,368	3,133	2,102	5,265	2,725
	1902 ...	1,283	1,343	1,700	1,621	1,700	1,301	1,694	1,125	1,942	1,240	1,930	1,331
	1903 ...	2,889	2,402	2,862	2,096	2,477	1,346	2,665	2,859	3,010	1,863	2,910	3,191
	1904 ...	...	914	...	747	...	744	...	1,162	.	690	...	1,464
	1905 Grain ...	2,686	2,716	2,583	2,057	2,099	1,573	2,892	2,323	2,807	2,499	2,965	2,783
	1905 Straw† ...	9,983	13,522	11,816	9,438	9,311	8,034	10,878	10,176	11,580	10,509	9,862	11,471

*(1) The figures for single years from 1882—1894
(2) The years 1887 and 1888 are excluded from the
† Moisture 75·05.

grain in the standard and alternate series.

Poudrette at 50 lbs. nitrogen per acre.		Saltpetre at 25 lbs. nitrogen per acre.		Saltpetre at 25 lbs. nitrogen and bone-dust at 10 lbs. nitrogen per acre.		Saltpetre at 25 lbs. nitrogen and bone-superphosphate at 10 lbs. nitrogen per acre.		Ashes of 180 maunds of cow-dung per acre.		Ashes of 180 maunds of cow-dung and saltpetre at 25 lbs. nitrogen per acre.		No manure.		Remarks.
Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	
1,146	957	1,099	757	1,174	931	1,052	881	821	628	1,207	1,130	617	413	
1,367	1,067	794	778	899	952	1,212	872	682	683	1,276	984	695	570	
2,232	1,325	850	787	1,437	1,089	1,624	898	995	750	1,703	1,007	1,059	774	Alternate B.
2,035	2,021	1,119	714	1,065	430	877	375	1,349	607	910	853	472	200	Do. A.
3,225	2,372	2,544	2,228	2,695	2,493	2,816	1,410	2,411	2,133	2,713	2,015	2,021	1,857	Do. B.
2,396	2,105	1,295	1,222	2,614	1,309	1,888	1,162	1,210	956	2,033	1,730	1,307	460	Do. A.
2,420	2,045	1,997	717	2,329	1,125	1,945	1,237	1,664	871	2,169	1,773	1,476	1,177	Do. B.
2,462	1,974	1,561	1,134	2,028	1,289	1,830	1,016	1,526	1,063	1,906	1,476	1,267	894	
3,182	2,974	2,190	2,257	2,151	2,438	2,738	2,184	1,755	1,712	2,202	2,166	1,682	690	Alternate A.
2,925	2,009	2,396	1,912	2,244	2,175	2,196	1,963	1,464	1,452	2,314	2,154	1,730	1,249	Do. B.
2,099	1,997	1,281	1,295	1,915	1,392	1,246	1,310	1,895	750	1,470	1,131	1,316	889	Do. A.
2,968	2,611	2,000	1,860	2,290	2,299	2,021	1,782	1,092	1,219	1,933	1,803	1,080	959	Do. B.
...	1,192	...	339	...	723	...	844	...	448	...	992	...	309	Do. A.
2,505	1,736	2,263	2,021	2,668	2,027	2,341	2,057	1,337	1,367	2,287	1,863	1,029	1,888	
11,156	9,335	10,080	11,568	10,134	11,416	10,739	9,293	9,553	8,446	11,035	9,499	9,510	7,635	Do. B.

will be found in the report for 1900-1901.
average, as the crops were almost entire failures.

Wheat.—The two series bearing wheat were treated as follows:—*Rabi standard.*—Ploughed four times
Alternate A.—Ploughed five times, subsoiled once, cultivated with the Planet Jr. Cultivator four
The manures were spread on 22nd and 23rd October 1905 except saltpetre which was applied in two
The seed was sown with the country plough on 24th October at the rate of 120 lbs. per acre and the
The results of the current and previous years are given in the following table :—

Acreage outturns (in lbs.) of wheat grain

Plot area.	Year.	Cow-dung at 100 lbs. nitrogen per acre.		Cow-dung at 50 lbs. nitrogen per acre		Residue of cow-dung applied in previous years.		Sheep-dung at 100 lbs. nitrogen per acre.		Sheep-dung at 50 lbs. nitrogen per acre		Poudrette at 100 lbs. nitrogen per acre.	
		Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.
Each plot is equal to 400 square yards.	Average for five years, 1885 to 1889.	1,184	1,394	1,338	1,339	1,258	1,361	1,219	1,517	1,051	1,511	1,253	1,642
	Average for six years, 1890 to 1895.	1,613	1,743	1,685	1,606	1,560	1,581	1,691	1,690	1,694	1,954	1,653	1,792
	1896 ...	2,765	2,184	2,910	1,900	2,904	250	3,001	3,120	3,206	3,104	2,819	3,092
	1897 ...	2,558	2,729	2,472	2,553	2,558	2,716	2,967	2,868	2,107	2,777	2,889	3,219
	1898 ...	2,384	2,202	2,880	2,239	2,069	2,021	2,543	2,880	2,396	2,565	2,202	2,372
	1899 ...	2,184	2,505	2,363	2,384	2,156	2,217	2,505	2,741	2,232	3,028	2,245	2,356
	1900 ...	2,729	2,795	2,937	2,456	2,659	2,229	3,089	3,004	2,741	2,816	2,490	2,598
	Average for five years, 1896 to 1900.	2,524	2,483	2,712	2,306	2,471	2,339	2,821	2,923	2,536	2,858	2,529	2,727
	1901 ...	1,485	1,906	1,652	2,021	1,337	1,960	1,797	1,688	1,431	1,936	1,367	1,676
	1902 ...	2,565	3,031	2,686	2,952	2,450	2,426	2,075	2,396	2,414	3,037	2,166	2,608
	1903 ...	2,595	3,243	2,493	2,704	2,456	2,771	3,061	2,698	2,813	3,606	2,184	3,285
	1904 ...	1,930	2,856	2,644	2,559	2,003	2,281	2,626	3,019	1,694	2,547	2,245	2,856
	1905 ...	1,252	1,476	1,348	1,292	974	1,065	1,101	1,283	1,065	1,543	941	1,301
	1906 Grain ...	2,535	3,158	2,729	3,267	2,118	2,789	2,741	3,340	2,196	3,237	2,608	†
	1906 Straw ...	4,335	7,641	3,812	5,977	2,801	5,802	4,168	8,213	3,612	6,770	3,926	†

* (1) About a third of this plot has the disadvantage of
(2) The figures for 1883 and 1884 are purposely left out
(3) The figures for single years, from 1885—1895, will
† Not recorded owing to some mistake in determining outturn

subsoiled once, cultivated with the Planet Jr. Cultivator three times and levelled five times.
times, *bakharing* once and levelled six times.
instalments on the 15th of November 1905 and 3rd of January 1906.
land levelled. The crop was weeded once, watered three times and harvested on 7th to 16th April 1906.

in the standard and alternate series.

Poudrette at 50 lbs. nitrogen per acre.		Saltpetre at 25 lbs. nitrogen per acre.		Saltpetre at 25 lbs. nitrogen and bone-dust at 10 lbs. nitrogen per acre.		Saltpetre at 25 lbs nitrogen and bone-superphosphate at 10 lbs. nitrogen per acre.		Ashes of 180 maunds of cow-dung per acre.		Ashes of 180 maunds of cow-dung and saltpetre at 25 lbs. nitrogen per acre.		No manure.		Remarks.
Standard.	Alternate.	Standard.*	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	Standard.	Alternate.	
1,177	1,325	1,314	1,406	1,398	1,726	1,131	1,557	829	1,246	1,208	1,405	888	1,082	
1,797	1,874	1,481	1,573	1,484	1,748	1,681	1,704	1,339	1,448	1,568	1,731	1,104	1,308	
3,146	2,983	1,839	2,353	2,063	1,516	2,426	1,927	2,202	2,090	2,396	2,408	2,257	1,183	Alternate A.
2,466	2,952	1,853	2,535	1,948	2,589	2,236	2,559	1,757	1,785	2,188	2,474	1,723	1,936	Do. B.
2,263	2,553	1,851	2,045	2,154	2,263	2,468	2,360	1,742	1,307	1,827	2,142	1,416	1,246	Do. A.
2,680	2,898	2,242	2,608	2,287	2,689	2,360	2,602	1,851	1,761	1,567	1,597	1,386	1,658	Do. B.
3,004	2,952	2,323	2,768	2,420	2,592	2,961	2,704	2,154	1,779	2,251	2,444	1,951	1,500	Do. A.
2,712	2,868	2,022	2,462	2,174	2,330	2,490	2,430	1,941	1,744	2,046	2,213	1,747	1,505	
1,434	1,588	1,077	2,118	1,379	1,960	1,621	1,821	1,071	1,473	1,506	1,900	1,189	1,410	Alternate B.
2,719	2,810	2,220	2,577	2,205	2,668	2,650	2,771	2,353	2,565	2,323	2,335	1,936	1,724	Do. A.
2,305	3,285	1,773	2,502	2,093	2,045	3,025	2,910	1,894	2,118	2,066	2,886	2,366	1,969	Do. B.
2,481	2,523	1,470	2,595	1,821	2,874	2,390	2,934	1,150	2,317	2,208	2,287	1,476	1,059	Do. A.
1,252	1,337	1,222	1,237	1,428	1,494	1,283	1,325	666	998	1,228	1,476	626	877	Do. B.
2,608	3,079	1,579	3,207	2,027	3,001	2,087	3,122	1,640	2,777	2,003	2,741	1,500	1,785	Do. A.
4,126	8,325	2,695	5,022	2,762	5,251	2,825	6,903	2,692	4,583	3,216	3,570	2,178	2,239	

adjoining trees, and bears every year a strikingly poorer crop than the rest of the plot.
of account.
be found in the report for 1900-1.

(2) EXPERIMENT WITH ARTIFICIALS ON COTTON.

The object of the experiment is to test the value of various artificial manures as applied to cotton and to ascertain what reduction of present prices will be necessary before their application can be considered profitable.

The experiment was started in the year under report, the land selected has not been manured for sometime but lies in an area of good natural fertility and had been practically cropped alike for the last five years.

Plan of the experiment.

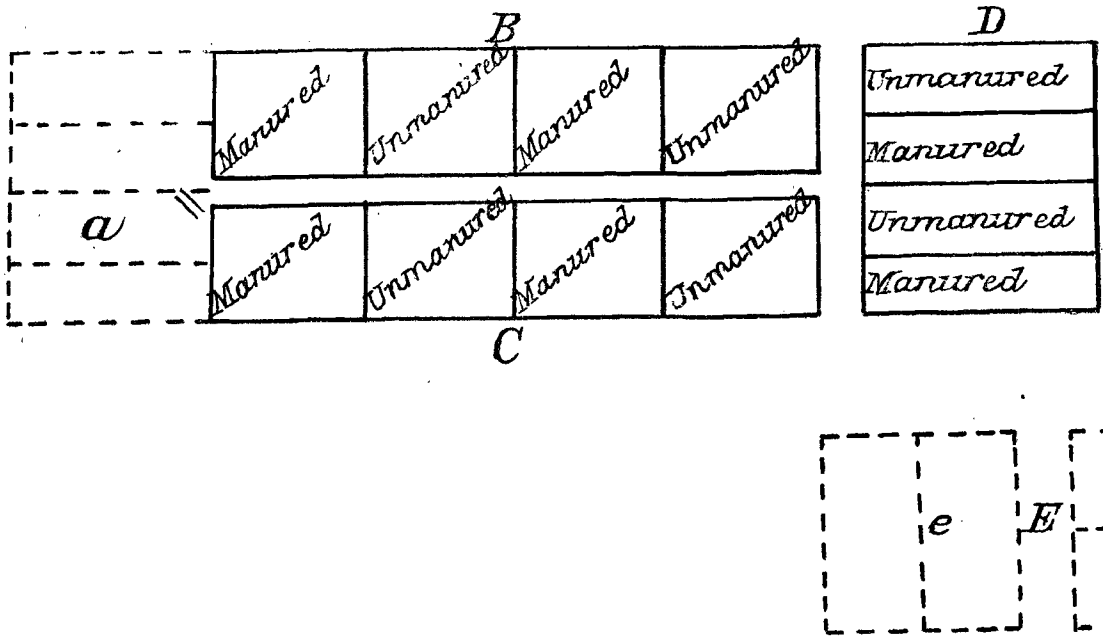
The ground has been divided in three blocks B, C and D.

Block B.—Superphosphate at 50lbs. phosphoric acid per acre.

Block C.—Superphosphate at 50lbs. phosphoric acid and Ammonia Sulphate 20lbs. nitrogen per acre.

Block D.—Farm-yard manure at 20lbs. nitrogen and Superphosphate at 50lbs. phosphoric acid per acre.

Each block consists of 4 plots of $\frac{1}{8}$th acre each, two manured and two unmanured as per diagram.



N.B.—About 8 feet roadway has been left between the blocks and 5 feet between each plot, the plots themselves being permanently marked at each corner by iron pegs.

The land was flushed in June and ploughed once with Watts' plough and once with country plough. The manures were applied before sowing, the artificials being worked into the soil so as to be directly in the line of plants. Seed was dibbled in rows 2 feet apart and 2 feet from plant to plant. Gaps were resown as soon as possible but in spite of this a considerable difference in the number of trees occurred in each plot reaching from 200 to 1,500 plants in some cases per acre. The actual comparison at the time of picking, however, was made from an equal number of trees in each case as shown in the statement of outturns.

Exactness and duplication so as to make a fair and equal comparison has been the keynote of the experiment and it must be confessed that a comparison of the outturns is not encouraging.

The fact that the plants were exactly spaced allowing of interculture and cross-culture with the Planet. Jr. Cultivator (a considerable convenience to us when condition admits of it) may have had something to do with the equal good outturns of the unmanured plots. But the experiments carried out in the cotton States of America show that the best results of cotton manuring are obtained when the accumulative effects of the manure begin to show themselves, which in this case it has not yet had an opportunity to do.

The plots have again been manured and sown in the present season and in addition two similar blocks (*a* and *e*) each of 4 plots have been added as per dotted lines in the diagram. In (*a*) ammonia sulphate has been applied alone at the rate of 20lbs nitrogen per acre; in (*e*) farmyard manure only has been applied to supply 40lbs of nitrogen per acre.

These additions have been made in the hope that if any distinct advantage can be seen from the above applications the actual effect of each individual fertilizer may be more correctly estimated.

The land will thus be sown two years running with cotton in order to obtain more quickly any accumulative effects of the manure.

Hereafter I propose to grow the cotton and wheat alternately as continuous cotton growing is not practised in this province and by the cultivator is considered bad farming. Thus

باڑي ميں باڑي کرے کرے ايکهه ميں ايکهه * وه گهر يوں هي جائينگے جو سنے پرائي سيکهه

(Those who sow cotton after cotton and sugarcane after sugarcane and who act according to the advice of others are sure to be ruined.)

Statement showing the acreage outturn of manurial experimental plots.
"Desi Cotton."

Outturn of equal number of plants.

Field.	Plot area.	Treatment. Name of manure.	Percentage of nitrogen.	Quantity of manure.	Equal No. of plants per plot.	No. of plants per acre.	Outturn per acre. Fibre. lb	Fibre. oz.	Seed. lb	Seed. oz.	Remarks.
Block B 1	1/8th acre.	Superphosphate at 50 lbs. phos. acid per acre.	phos. acid 17	294	1027	8216	205	10½	485	1½	
Block B 2	Do.	Unmanured ...	...	...	1027	8216	226	14	535	2	
Block B 3	Do.	Superphosphate at 50 lbs. phos. acid per acre.	phos. acid 17	294	1027	8216	221	8	522	8	
Block B 4	Do.	Unmanured ...	...	...	1027	8216	234	10	553	6	
Block C 1	Do.	Sulphate of Ammonia at 20 lbs. nitrogen per acre. Superphosphate at 50 lbs. phos. acid per acre.	20·32 / phos. acid 17	98·4 / 294	1027	8216	267	1	629	15	
Block C 2	Do.	Unmanured ..	...	...	1027	8216	252	2	594	12	
Block C 3	Do	Sulphate of Ammonia at 20 lbs. nitrogen per acre. Superphosphate at 50 lbs. phos. acid per acre.	20·32 / phos. acid 17	98·4 / 294	1027	8216	301	7	711	1	
Block C 4	Do.	Unmanured ...	...	...	1027	8216	309	6	729	10	
Block D 1	Do.	Farm yard manure at 20 lbs. nitrogen per acre.	·43	4651 / 294	1027	8216	236	12	558	8	
Block D 2	Do.	Superphosphate at 50 lbs. phos. acid per acre.	phos. acid 17								
Block D 3	Do.	Unmanured ...	...	...	1027	8216	272	15	643	13	
		Farm yard manure at 20 lbs. nitrogen per acre.	·43	4651 / 294	1027	8216	265	12	626	12	
Block D 4	Do.	Superphosphate at 50 phosphoric acid per acre.	phos. acid 17								
		Unmanured ...	...	...	1027	8216	250	4	590	4	

The following shows the outturn of two adjoining plots, each 1/8th acre, sown broadcast. The whole question of sowing and cultivation will be taken up at the Aligarh station which will be more particularly devoted to cotton.

Field No.	Plot area.	Treatment. Name of manure.	Percentage of nitrogen.	Quantity of manure.	Equal No. of plants per plot.	No. of plants per acre.	Outturn per acre. Fibre. lb.	Fibre. oz.	Seed. lb.	Seed. oz.	Remarks.
Plot. 1	1/8th acre.	Farm yard manure at 20 lbs. nitrogen per acre Superphosphate at 50 lbs. phosphoric acid per acre.	·43 / Phos. acid 17	4651 / 294	3500	28000	180	13	426	7	Sown broadcast.
Plot. 2	Do.	Unmanured ...	...	...	Do.	Do.	177	6	418	6	

(3) EXPERIMENT WITH *NEEM*-CAKE AND COTTON REFUSE.

This experiment was started last year with four plots including one with poudrette and one unmanured for comparison. The *neem* cake was tried at the request of the Inspector-General of Agriculture, cotton refuse at the suggestion of Mr. West of the Victoria Mills.

The outturns are given below :—

Acreage outturn of potato grown with different manures.

Plot No.	Plot area.	Manure applied.	Percentage of nitrogen.	Actual quantity of manure in lbs.	Outturn in lbs. 1904-1905.	Outturn in lbs. 1905-1906.	Remarks.
1	$\frac{1}{12}$th acre	*Neem*-cake at 200 lbs. nitrogen per acre.	4·81	4,152	6,066	8,544	
2	„	Poudrette at 200 lbs. nitrogen per acre.	·31	64,512	7,032	6,948	
3	„	Cotton-refuse at 200 lbs. nitrogen per acre.	·86	23,268	4,224	7,186	
4	„	Unmanured ...	...	...	3,600	3,540	

The increase in outturn from cotton refuse over last year's is no doubt due to the manure being in a well rotted condition when applied ; in the previous year, as mentioned in that report, it was not received in time. Compared with previous experiments with poudrette and other manures the outturns are low, but the land has had no manure for several years.

(4) GREEN MANURING.

Plot I—wheat after hemp (crotolaria juncea) ploughed in.
„ II—wheat after *khurti* (Dolicos biflorus) ploughed in.
„ III—wheat after *urd* and *mung* (phaseolus *mungo* and radiatus) ploughed in.
„ IV—wheat every year after a summer fallow.

Details of cultivation.

For the kharif crop—hemp, *khurti* and *urd* + *mung*—the plots were ploughed twice and levelled after each operation.

Seed was sown broadcast on July 1st and covered in with the Planet Jr. Cultivator. The standing crops were laid down by *patah* on September 1st and then ploughed in.

For the following wheat crop, plot IV was ploughed five times, plots I to III twice after September 1st. All plots were cultivated twice and levelled three times. Seed was sown behind the plough on October 22nd. Owing to deficient rain the plots were flushed before sowing, and the crop subsequently received three waterings and one weeding.

Outturns of green-manuring plots in pounds.

Field No.	Area.	Crop and treatment.	1902-3.	1903-4.	1904-5.	1905-6.
27A/1	778 square yards.	Wheat (after hemp)	980	1,017	756	760
27A/2	778 square yards.	Wheat (after *khurti*)	818	1,166	889	853
27A/3	940 square yards.	Wheat (after *urd*)	835	1,038	617	764
27A/4	890 square yards.	Wheat	*481	1,151	932	

* Waterlogged.

† Not recorded owing to some mistake in determining outturn.

CHAPTER II.

TRIALS OF DIFFERENT VARIETIES OF CROPS.

(1) *Sugarcane.*

Mauritius cane.—This cane was obtained originally about three years ago from Burma by the Assistant Director, the variety having been highly praised by the "Indian Agriculturist." Only a few sets of those received in the first instance germinated, the amount being gradually increased and a few distributed.

In the year under report the canes grew to considerable height and thickness, some reaching 5 lbs. in weight. As many canes as were available were distributed for sowing to those especially asking for them and a sample was sent to Messrs. Begg Sutherland and Company for analysis at the request of the Secretary to the Chamber of Commerce, Cawnpore.

Shamshera and Puri canes.—Two varieties of canes from Bengal, Shamshera and Puri have been tried on small plots at the Farm for the last two or three years. They have never proved equal, in Cawnpore, to the local variety grown, but have enabled us to supply some seed to indentors in other parts of the Province anxious to give them a trial.

(2) *Solanum Commersonie, "the new potato."*

This potato has been reported on in the journal of the Board of Agriculture and India Planting and Gardening as having been improved from a small bitter tuber to a promising new variety capable of growing in damp places and being disease resistant. After some difficulty five small tubers were obtained, but unfortunately they arrived in the hot weather. In May two tubers were sown and grew fairly well in pots until unluckily destroyed by squirrels. The remaining three tubers are still in hand; they do not look very hopeful, but will be tried with the coming cold weather. This is hardly the place to enter into the history and description of the potato, but though only recently mentioned as experimentally cultivated by M. Labergerie the plant is not new, having first been noticed by the French Botanist M. Philibert Commerson between 1727 and 1773 in the Wild State (Uruguay) and described by Dunal in 1816 under the above name.

(3) *Sweet potato.*

Three varieties of American sweet potato have been given a trial for the last two years on small plots. This experiment has not been previously reported on, as, in the first instance, the sets received were very few and only three or four rows were sown of each kind the first year. The plan of the experiment has been two-fold :—

I.—To test these American varieties against the indigenous ones.

II.—To test the country methods of sowing against the American method.

The results although on a small scale seem to show clearly that:—

I—the American varieties are not superior to the country ones in outturn; moreover they are inferior in quality:

II—the local method of planting has proved superior in both years for the Americans and for the country red, while for the country white, curiously in both years, the American method has proved best and seems worth trying on a large scale with this variety.

The following statement gives the outturn per plot in lbs. of each variety by both methods for two years:—

No.	Name of variety.	Outturn in lbs. per plot.			
		1905.		1906.	
		Foreign method.	Local method.	Foreign method.	Local method.
1	New Jersey ...	17	31	32	55
2	Virginia ...	7½	30	24	29
3	Nansemond ..	11	23	23½	32½
4	White of Cawnpore	31	26	106	93
5	Red of Cawnpore	33	55	60	70

Owing to the plots being so small, it seems better to give the actual outturns rather than represent them per acre. The quality of the American varieties gives no inducement to carry out their trial on larger areas.

(4) *Choha Saidan Shah maize.*—This maize was received from the Punjab, where it is said to be very productive. It has been tried for the last three years at the Farm, but shows no indications of being superior to indigenous kinds. In 1903 it gave 2,058 lbs. of grain, or less than Jaunpur maize when grown under similar conditions. In 1904 it failed owing to execessive rain. In 1905 fresh seed was again obtained from the Punjab and sown on a plot of $\frac{1}{6}$th acre and manured with poudrette at the rate of 100 lbs. nitrogen per acre. The yield was 1,944 lbs. of grain while that from the kharif standard and alte nate plots 2,965 lbs. and 2,783 lbs. respectively per acre, the conditions being very similar, consequently it does not give sufficient promise to make it worth introducing.

(5) The varieties of Til seed obtained from the Agricultural Chemist, in consequence of their analyses showing a high percentage of oil, were again tried, but they proved a total failure, and are quite unfit for this province as far as one may judge from Cawnpore experience.

The following were the varieties tried :—

1. Ahmad Nagar Til.
2. Sholapur Til.
3. Kavara Til.
4. Dharwar Til.

CHAPTER III.

THE IMPROVEMENT, SELECTION AND STUDY OF COTTON, POPPY, MAIZE AND RICE.

I. Cotton.

Indigenous cotton.—Samples of seed were obtained from all parts of the province and from the surrounding native states, and were sown on some 5 acres at the Experimental Station at Cawnpore and the station at Orai. I have thus had an opportunity of studying both from a botanical and an economic point of view all the available indigenous varieties in this province and of selecting in the first instance from some thousands of representative trees. By far the largest number of varieties received under local names are identical and all, more or less, consisted of a mixture of plants, bearing yellow and white flowers and with narrow or broad lobed leaves while considerable differences in lint occurred both as to quantity and quality.

Consequently to commence to draw comparison of outturn, &c., from so-called local varieties when each in themselves consisted of a mixture of plants differing in habit and in quality and quantity of lint was absolutely absurd. I therefore, in the first instance, confined myself to selecting out the different types and

collecting as much seed as possible of each for future sowing and comparison. These selections may be tabulated thus:—

I.—Individual superior trees.

II.—Trees of apparently productive variety.

III.—Varieties and forms.

In making a comparison of respective plant merits there opens up a large question as to how this can best be done.

In the first instance, with so large a number it is quite impossible to carry out a comparison on plots of any size; for size without duplication is of little value, there being no certain equality of soil. Moreover it is equally necessary to have an exact number of trees on each plot and thus on a large area exact work cannot be done for results depend too much on the work of assistants and labourers and become valueless. Further there is great difficulty in getting a large area sown at the same time and the chance of accidents, such as sudden rainfall, closing of the canal &c. are greatly increased especially when other large areas also require to be sown at the same time, often rendering after-comparison almost impossible. The primary comparison of selected plants has therefore been arranged on small duplicate plots each sown to contain 100 trees. This carries into the trial an exactness which, in my opinion, can be obtained in no other way and will enable one later to thoroughly test the individual and inherent value of any plant or variety of plants. Finally the most promising will be compared on larger duplicate areas on the different experimental stations and the seed of any definite superior strain thus obtained distributed amongst cultivators.

The following forms a list under their local names of the varieties under trial at Cawnpore, for other work in this connection my reports on other stations may be consulted :—

List of country cottons compared on duplicate plots, each plot sown to contain one hundred plants.

1. From Dholpur Bari yellow flower narrow lobed.
2. „ Gwalior Bagchini yellow flower narrow lobed.
3. „ Jeypur cotton No. 1 yellow flower narrow lobed.
4. „ Bagbara Mahlan yellow flower narrow lobed.
5. „ Cawnpore Desi (Blk. and W.) yellow flower narrow lobed.
6. „ Dholpur Bari yellow flower broad lobed.
7. „ Gwalior Bagchini yellow flower broad lobed.
8. „ Jeypur cotton No. 1 yellow flower broad lobed.
9. „ Cawnpore Desi (B. and W.) yellow flower broad lobed
10. „ Dholpur Bari white flower narrow lobed.
11. From Gwalior Bagchini white flower narrow lobed.
12. „ Jeypur cotton No. 1 white flower narrow lobed.
13. „ Chandausi cotton white flower narrow lobed.
14. „ Cawnpore Desi (P. and W.) white flower narrow lobed.
15. „ Jeypur cotton No. 1 white flower broad lobed.
16. „ Row No. 17.
17. „ ditto 29.
18. „ ditto 31.
19. „ ditto 32.
20. „ ditto 34.
21. „ ditto 35.
22. „ ditto 36.

The following cottons have been collected when on tour from different parts of Bundelkhand to obtain a more definite knowledge as to the location of varieties if any exist in case of future need of seed supply from one place to another :—

1. Karwi cotton from Bargarh direction.
2. Benari, Karwi.
3. Badausa cotton.
4. Bisenda cotton.
5. Mahua Girwan.
6. Baberu cotton.
7. Kulpahar.

Further study in this respect will be continued as time and space are available.

Cottons compared on other small plots :—

1. Bakand white flower G. Neglectum Varnov Rosea.
2. Tihaya yellow flower G. Neglectum Varnov vera.
3. Akhaipur from village of that name in Aligarh famous for its cotton (not classified yet).

Foreign cottons allied to Indian types, kindly obtained by the Secretary to Chamber of Commerce, Cawnpore.

1. Zargan cotton from Persia (not yet classified).
2. Abadeh cotton from Persia (not yet classified).
3. Khorasan cotton from Persia (not yet classified).

A few seeds of the following varieties have been selected and sown, but are not sufficient for any comparison this year :—

1. Bagbara mahlan, yellow flower, broad lobed.
2. Dholpur Bari, white flower, broad lobed.
3. Gwalior Baghchini, white flower, broad lobed.
4. Chandni cotton, white flower, narrow lobed.
5. Chandausi cotton, yellow flower, narrow lobed.
6. Chandni cotton, yellow flower, narrow lobed.

Miscellaneous cottons for observation or identification :—

1. Peri cotton from Bareilly.
2. Ujjain cotton.
3. Assam cotton.
4. Radhiya cotton of Allahabad.
5. Bagli of Sultanpur.

American varieties of cotton.

These varieties of cotton (*G. Hirsutum* mill.) received or retained under the following names have grown and acclimatized for many years in the Experimental Station at Cawnpore :—

(1) Form variety no. 1.
(2) Watagodu.
(3) Hybrid.
(4) Allen.
(5) Cook's long staple.

With regard to the first four there is practically little difference in fact, rather more difference exists between individual plants in the same plot than between the plots themselves.

With regard to Cook's long staple it is a decidedly longer and better staple, but the plants are more delicate and have shown themselves unsuitable to this district, but may do better in Aligarh with its low rainfall. While the first four are capable of being grown under suitable conditions in parts of this province their introduction largely depends on the question of price received for the lint. As will be seen from the annual report of the Department, steps have been taken for their introduction &c. and about one hundred acres have been sown. While these acclimatized varieties suffer more from insect pests they have this advantage over the ordinary country ones that they possess both quality and productiveness of lint, whereas with provincial varieties almost invariably quantity goes with coarseness and quality with scanty lint. Consequently it is possible that with a suitable price ensured to the cultivator they may yet meet the requirement for a superior lint to a limited extent, while the coarser indigenous varieties hold their own for productiveness and hardiness.

In the same way as the indigenous varieties are under a process of selection these American varieties have been taken in hand although to a less extent as their future is not yet ensured. At present the lint contains a good deal of short stuff, which it is desirable to get rid of and the seeds are covered by a large amount of green fuzz. This latter fact is distinctly disliked by cultivators, because disliked by cattle, and is in fact liable to be injurious to them. Consequently an attempt is being made to get rid of this character and to produce a more even lint at the same time a productive and hardy tree. Some tests in this direction showed differences of congenital descent varying from 1 to 2 per cent. to 75 per cent. of desired character.

Other varieties of cotton such as South Sea Island, Peruvian, Brazilian, Burlion and Egyptian are grown on small botanical plots. They have all been proved unsuitable to this district. Some plants of caravonica nos. I and II have also been sown, but are hardly likely to suit the conditions of this province.

The results of past experiments at Cawnpore have gone to show that if a better and longer foreign cotton can be introduced, the present variety of *G. Hirsutum* acclimatized at Cawnpore is the most likely to be successful. The question is further dealt with in the annual report of the Department.

Botanical work on certain types and forms of cotton :—

This consists in a study of the stability or variation of Indian cotton plants.

I.—When various type-species collected on tour in other parts of India are sown here at distances sufficiently apart to prevent chances of cross-fertilization.

N.B.—The seed was collected by myself from typical specimen at Poona as grown and described by Professor Gammie.

II.—When various species, varieties and forms differing in leaf, colour of flower, shape of boll, quality of lint and the absence or presence of glands &c. are grown together.

The former are represented by 10 type-species; the latter from some 50 different plants but including many duplications.

I may say here that the plants have been growing in my own garden on new land, that I have myself picked all cotton, that I collected nothing unless actually taken from the boll, that every other detail has been done by me except the ginning and sowing and that these operations have been done before me with the utmost care.

This work has been started on account of differences of opinion which still exist as to whether the many and often over-lapping forms in cotton are due to cross-fertilization, or to a natural tendency of the plant to vary, especially when transferred from one soil and climate to another.

To prove the first it is necessary that the various forms be scientifically worked up and established by cross-fertilization between species and varieties. So far according to Professor Gammie, who has produced a large number of artificial hybrids, not one of them can be matched with any known variety. For proof of the second that the process of variation be clearly proved by the origin of existing forms from disinct types, grown at such distances apart as to prevent any chance of hybridization.

(2) Poppy Selection.

In 1904 the seed of certain varieties of opium-poppy were received from the Opium Department. These, on sowing, proved to be anything but true to seed and the work of the first year was confined to selecting out the principal types. Opium was collected in due course and sent to the factory but collection was a minor matter in this stage. The only previous attempt at poppy selection has been that carried out by Mr. John Scott, on special duty, in 1874. This was suddenly cut short and so no lasting results were obtained. The experiment as carried out by Mr. Scott consisted in comparing the results between the seed produced from untapped capsules as against those tapped, and also selecting seed from those plants giving the largest amount of exudation. From the results of his experiments with untapped capsules *versus* tapped capsules he seems to have come to the conclusion that the latter produced the best seed. As regards the improvement he claimed for his selected seed there was a good deal of difference of opinion but in any case he never had a fair chance to establish his claims fully. But one result, not particularly advantageous and which he himself admitted, of selecting seed from those capsules giving the greatest amount of exudation, appears to have been a distinct increase in the proportion of *pussewah*.

The present plan of experiments which I am carrying out goes a step further than the previous attempt and aims at not only selecting the most productive plants but in testing the capability of these plants to reproduce in their offspring the same indications of high production. In fact carries into the method of plant selection as far as possible the same principles which have been entered into animal selection and without which no certain progressive improvement can be made. The mere selection of the most productive plants may tend to keep up the qualities of a strain when once obtained but too many accidental circumstances enter into the growth of a plant to accept the simple fact in one instance of high production as indicating its possessing this character as an inherent quality.* Moreover, in determining the value of individual plants I am not relying on mere guess work based on the apparent exudation, but am taking the actual quantity of weighed opium from each plant. By this means I shall be able to guard against the disadvantage of an increased production of *pussewah* and have a firm basis on which to make my selection. This selection at present is being carried out on two varieties Katila and Lambki; fifty of the most vigorous plants were selected from each plot and the exudation from each plant weighed, from these some seven plants have been selected of each variety as comparatively highly productive, *i.e.* producing from 4 to 6 grains of opium as against 2 and 3 grains in other cases. Next year the seed from these plants will each be sown separately in duplicate plots. One hundred of the most vigorous plants will in each plot be selected and their total produce weighed

* Note.—Many good cultivators do only select seed from capsules allowing of two or three scarifications. In this way if their selection has been continuous, they may have reached in long years an average in productiveness which it is not possible to go beyond, at least not to maintain without an exactness in selection hopeless to expect.

separately, the final selection resting with those progeny which show the greatest average tendency to reproduce the parent feature of high opium production. The seeds from these plants will then be sown on a more extensive scale on duplicate plots with ordinary seed received from the Opium Department, and a comparison made as to their relative production. Thus until this stage is reached, no conclusion can be drawn. A moment's consideration will show that on this plan not more than one or at most two varieties can be taken up at a time. The work is tedious and exacting, presents many difficulties such as cross-fertilization etc., and it is only the high value of the product and the care with which its cultivation is carried on that makes such systematic selection worth undertaking. At the present time as indicated by the seed received from the Opium Department, the poppy seed sown is more or less of a mixed nature and as in all plants and animals there undoubtedly exist individuals of high excellence and prepotency which may with advantage be selected. It is hoped that under the methods above delineated a race of superior productiveness may be obtained, not one merely raised above the average by high cultivation* but one containing intrinsic and lasting qualities as long as it is kept pure and the seed from the most vigorous plants is retained for each successive sowing.

3. *Selection of two cobbed maize.*—The selection commenced last year and the difference in outturn between the best single cobs and the best double cobs was then compared which was manifestly greatly in favour of the latter. The seed from the double cobbed plants were sown far apart and the average production of double cobbed offspring of each parent plant noted. An inspection of these shows clearly that choice founded on mere external character, is not to be depended on for raising a double cobbed strain and illustrates the importance of the methods adopted in the selection of poppy and cotton.

Plot	No. I	produced	51·88	per cent. double cobs.	All plots unmanured but in good condition.
,,	,, II	,,	5·51	,, ,, ,,	
,,	,, III	,,	4·19	,, ,, ,,	

An average of all three offsprings gives little more than 20 per cent. double cobbed plants which is no better than in any ordinary crop. Seed only from No. 1 has been sown this year and has yet to be harvested. The experiment at present merely constitutes a preliminary trial in order to form some opinion if work on these lines with a crop like maize is possible. For besides the difficulty of carrying selection on these lines with crop which so easily cross-fertilizes, well manured land will produce a large number of two cobbed plants over unmanured land without any selection.

4. *Rice.*—A small amount of work keeping only one definite point in view has been done with this crop; and has consisted in trying to raise a cross with some of the qualities of the best sorts while retaining the habit of *sathi* with its grain covered till maturity. The object of this work is to meet the ravages of the rice sapper (Leptocorisa acuta) which in some years is so injurious to the better sorts of rice, while the inferior *sathi* from the nature of its covered grain practically escapes. In commencing this work last year I was met with the difficulty, perhaps peculiar to these parts, of the glumes being so brittle that opening by the usual method adopted in crossing wheats ruptured the tissues at the base, and the glumes refused to return to their natural position, apparently at the same time injuring the ovary so that no fertilization took place. I then endeavoured to effect fertilization by cutting the keel of the glume lengthways and fertilizing through the expanded edges. In this manner I was likewise unsuccessful but was only able to try the method in one or two cases, the season then drawing to a close. This year I have made arrangements for growing rice in pots outside my laboratory so that measures may be taken, which will perhaps effectively at the right time get rid of the brittle condition of the glumes for the purpose of cross-fertilization.

CHAPTER IV.

Rust on wheat.

A note on this subject in conjunction with the Imperial Mycologist has appeared separately. The growingof wheat at Cawnpore under certain protective conditions has been continued, while a careful watch on the first appearance of rust is being kept to collect any evidence with regard to rust starting from definite

* NOTE.—To prevent unevenness no manure is directly applied to the plots but seed is sown on land in good "heart" after a bare summer fallow.

centres. For this purpose I have adopted the method of putting thirty to forty hands over the wheat in the early stage and at weeding time with the standing offer of a good reward for the first rust shown to me.* By this method I have been able to check my own observations and have found what appeared to me as the first circumscribed area of affection to be nothing of the sort and that in some field or other, the disease was, though confined more or less to the lower leaves, quite general. Although one cannot help but be struck by occasionally noticing small distinct and apparently circumscribed areas in the early part of a season, it is not clear how they originate and a careful search of the rest of a field has always revealed the fact that the disease has already spread beyond the apparent limit and that scattered about the field are plants with one or two spots or more on their basal leaves. It is hoped from a careful search each year by the plan mentioned, the course of the disease over a given area in the early stage may be more closely watched and the date of the earliest appearance reduced. Though the exact method of how the disease starts is hardly to be obtained by such methods alone, still it seems likely to add some thing gradually and help forward to a more definite knowledge.

In some other countries the possibility of rust being carried over from one wheat season to another by volunteer plants is fully recognized, but in the climate of this province it seems hardly likely. I have for the last two years made some attempts at deciding this question, the results of which only confirm the above opinion. Thus when sown by the side of a tank in the open at a level giving sufficient moisture to keep the plant alive, it has been destroyed by the rise of water in the rains. Sown on a slightly higher level under the shade of trees, squirrels have again and again rooted it up. Nevertheless I presupposed that wheat might manage to exist in some favourable spot and sowed seed at harvest time on somewhat low moist ground in the shade of trees, protecting from squirrels by netting and from drought by watering. Some of the wheat grew fairly well and feebly headed out towards the end of July when it, so to speak, ripened without forming seed. The wheat sown was *kathia* of Jalaun, a wheat which always badly rusts when brought to this district and irrigated. But no signs of any rust were observed in this case. Further the ripening of the wheat at the end of July necessitates the idea of fresh grain about this time again falling in some favourable spot and being ready to continue the disease up to the cold weather, if rust is to be carried over the summer season.*

But when one considers in the first instance that immediately prior to harvest the spores from any remaining uredospore pustules have but the most feeble germination. That late sown wheat kept well watered and ripening towards the end of May after all wheat crops have been harvested, showed no pustules of Puccinia glumarum or triticina; the principal rusts doing damage in this province but only those of P. graminis (always a late rust here) from which I got no spores to germinate. Consequently any thought of volunteer wheat carrying the disease over from one season to another seems hardly possible. The same may be said with regard to the uredospores themselves for if their vitality is feeble before harvest, after harvest and by the following wheat season it is absolutely nil. This I have tested preserving the spores in different ways over and over again during the last five years.

August 15th.—To-day for the first time a nearly matured volunteer wheat plant consisting of a single stem and head has been found near the wheat breeding house amongst some long grass. It is evidently of later growth than those mentioned as being sown and was growing also in a position where it was fairly well shaded and yet protected by its position from the attacks of squirrels. It was also close to some pots which were being constantly watered and hence received sufficient moisture. It shows no signs of rust.

Germination of teleutospores of Puccinia graminis glumarum.

These spores formed towards the end of the season and in some countries known to assist indirectly in carrying over the disease from one season to another have resisted all attempts to germinate them here. There are other cases of

* NOTE.—A more likely occurrence than during the previous period judging so far by wheat sown and now growin in the open. In fact several rabi crops germinate with the rains as gram and mustard, wheat and barley are also said to d so but I have not observed them.

spores equally obstinate, which have yielded in passing through the digestive tract of some animal and it was hoped that on discovering a caterpillar eating off the epidermis of the wheat leaves and passing large numbers of healthy looking teleutospores a solution of the difficulty had been obtained. But though attempts have been made at different times of the year to germinate these, they have remained inert and obstinate. After endeavouring in all kinds of ways and at different seasons over a period of five years to obtain germination I must confess this last failure of what seemed a hopeful chance is most disappointing.

The present position as to the spread of the disease stands thus:—

Professor Erikson (Stockholm) believes that the evidence as to infection could only be explained by the presence of a mycoplasm in the seed.

Professor Marshall Ward in opposition to Erikson maintains that there is no evidence to show that the fungus is spread in any other way than by spores and that his experimental and microscopic investigations do not in any way support Erikson's mycoplasm theory.

CHAPTER V.

Classification of wheat and juars.

Classification of wheat.—The following preliminary classification of the wheats of this province with alterations and several additions is a reprint of the same as drawn up for the report on the meeting of the Board of Agriculture. From the classification as it stands it would appear that the samples received were fairly pure, but in fact there was in many cases considerable admixture.

When these adventitious grains seemed in any way different from other wheats received they were retained for the time being under the name of "From so and so" as the case may be.

On the other hand when it was seen at once that they resembled some other wheat they were discarded altogether and only the correct types as denoted by the name, under which they were received, were kept.

It will also be noticed in some cases that wheats received as hard and *vice versâ* ,have not displayed this character exactly, both soft and hard grains sometimes occurring.

To what extent this was due to admixture I have not yet determined but in these wheats except in the case of "Buddha" (a true hard wheat) hardness does not appear to be of an altogether fixed character, some complete or slight variations in a grain towards softness often being noticeable. Thus to take for example Kathia of Jalaun, a hard red wheat but in which a few soft grains can always be found, while grains for the most part hard but with distinct light coloured spots of softness are common.

On fracturing such a grain the light coloured spot appears as a small circumscribed whitish starchy area against the reddish, hard and flinty appearance of the rest of the grain. Further to remove any doubt on the matter I selected out some of the hardest grains, I cut these in two, choosing twelve halves with embryos for the hard and flinty appearance and absolute freedom from any indications of softness of their fractured surface.

These I sowed in pots outside my laboratory and harvested the plants in due course.

After threshing a transverse section was made by me of every grain. The following gives the percentages of hard, soft and partially soft grains:—

Hard	...	0·3
Semi-hard (greater part of grain was hard)	...	8·8
Soft	...	24·4
Semi-soft (greater part of grain was soft)	...	67·0
		100·0

All operations were carried out by me from start to finish and unless one supposes some person having intentionally resown the pots with soft grains the results are conclusive as far as Kathia is concerned.

Further work on wheat consists in making the district collection complete and in verifying work in studying export demands and in gathering together local information as to the relation of varieties to soil, resistance to rust and drought, knowledge of the baking qualities, comparative prices and local estimation in which each variety is held. Until such information is gathered together any wheat work much beyond taking notes on the characters of the wheats as grown in Cawnpore, classifying and making a standard collection for future reference must be very empirical.

The following is a preliminary classification of the wheats of the United Provinces.

SECTION I.—BEARDED (AWNS MEDIUM).

Wheats.	Remarks.
(a) Spikes medium light straw colour or pale yellow, glabrous, awns 2½″ to 3″ long.	
(1) *a.—Soft white bran light straw colour*	
Dehra Dun, mihirta.	
Muzaffarnagar, Safeda.	
Meerut, soft white.	
From Bulandshahr, Safed.	
Ditto. ditto.	
Bulandshahr, Munia.	
Ditto, white.	
Ditto, Gajar.	
Muttra, Safeda.	
Etah	Mixed with nara.
Moradabad, Gajra.	
Ditto, Khadir awal.	
From Moradabad, Cawnpuri.	
Ditto, Safed doem.	
Badaun, Ratua	Mixed with hard.
Ditto, white	Ditto.
Kheri, soft white	Ditto.
Bahraich, ditto	Ditto.
Ditto, ditto No. 2	Ditto.
Gonda, Daudi	Ditto.
From Sitapur	Ditto.
Ditto, soft white,	
Unao, Safed.	
From Unao, Sambhargehna.	
Partabgarh, white.	
Benares, Daudi.	
Banda, Gangajali.	
From Banda, Pissi Gangajali.	
Banda Ujaria.	
From Banda, Ujaria.	
From Aligarh, unnamed,	
From Bijnor, Desitordar.	
Orai, Pissia white.	
From Meerut, Safed Gehun.	
From Sultanpur, Desi.	
From Meerut, Anokha,	
From Kheri, Seta.	
(I) b.—Soft white, bran reddish brown.	
From Sultanpur, Desi	Medium-soft.
Orai, Pissia (red).	
From Meerut, Anokha.	
Kheri, Lalwa.	
(II).—Hard white, bran light straw colour.	
From Bareilly, Kathia	Mixed with soft.
Aligarh, Kathia	Ditto.
Etah, Sambharia	Ditto.
Mainpuri, Sambharia...	Ditto.
Ditto, Anokha	Ditto.
Cawnpore, Tamra	Mixed with soft, sample not correct.
Meerut, Safed Gehun...	Medium hard.

SECTION I.—BEARDED—(continued).

Wheat.	Remarks.
(III).—Hard red, bran light straw colour	
Moradabad, Red Khadir	Mixed with soft.
Ditto, Surkh	Ditto.
Bahraich, Red soft	Ditto.
From Sitapur	Ditto.
Banda, Red hard	Ditto.
(IV).—Soft red, bran reddish brown.	
From Moradabad, Safed doem.	
Bulandshahr	Mixed with hard.
Fatehpur, Pissia awal	Ditto.
Banda, do. wheat	Ditto.
Ditto, red wheat	Ditto.
Lalitpur, Pissi doem	Ditto.
From Aligarh, unnamed.	
From Bijnor, Desitordar.	
(b) Spikes medium, whitish, downy, awns 2″ to 3¼″ long.	
Soft white, bran pale whitish.	
From Unao, Sambhargehna.	
(C) Spikes reddish brown, glabrous, awns 2½″ to 3″long.	
Hard white, bran pale straw colour.	
From Bareilly, Pissia.	
Bareilly, soft white.	
From Bareilly, Khathia.	
Shahjahanpur, Sambharia.	
Lucknow, Hamla.	
Unao.	
Partabgarh, Lalia.	
Gonda, Daudi.	
Basti, Gangajali.	
Azamgarh, Daudi.	
Cawnpore.	
From Banda, Pissia, (white).	
Ditto, Ujaria.	
Banda, Ujaria.	
From Banda, Pissia Gangajali.	
Orai, Pissia (white).	
Bijnor, Desitordar.	
Hard white, bran reddish brown.	
Orai, Pissia (red)	Medium hard.
Soft white, bran pale straw colour.	
Lakhimpur, Seta.	
Meerut, Sambharia	Medium soft.
Pilibhit, Sammaria	Awns 2″ to 2½″.
From Meerut, Katha.	
Sultanpur, Desi.	
Aligarh, unnamed.	
Orai, Pissia (white).	
Soft white, bran reddish brown.	
Lakhimpur, Lalwa	Awns 2″ to 2½″.
From Meerut, Katha.	
From Aligarh, unnamed.	
Bijnor, Desitordar.	
SECTION II.—BALD (OCCASIONALLY SHORT AWNED).	
(a) Spikes light straw colour glabrous.	
Hard white, bran light straw colour.	
Bulandshahr, Mendha.	
Moradabad, Mundia Safed awal.	
From Moradabad, Mundia Safed doem.	
Moradabad, Khirka awal.	
Do. Safed Mundia.	
From Moradabad, Katehar doem.	

SECTION II.—BALD (OCCASIONALLY SHORT AWNED)—(concld.)

Wheats.	Remarks.
From Moradabad, Cawnpore.	
Badaun, Ratua white.	
„ Bhamaria* white.	
Partabgarh, Mundwa.	
Sultanpur, Mundia.	
Soft white, bran light straw colour.	
From Bijnor, Mundia (red).	
Orai, Pissia (white).	
Soft red, bran reddish.	
From Bijnor Mundia (red).	
Orai, Pissia (red).	
(b) Spikes light straw coloured, downy.	
Soft white, bran light straw colour.	
From Saharanpur, Munda.	
(c) Spikes reddish brown, glabrous.	
Hard white, bran light straw colour.	
From Saharanpur, Munda.	
„ Moradabad, Katehra doem.	
„ Bareilly, Kathia.	
„ „ Pissia.	
„ Sitapur, Mundia.	
„ „ Muria.	
Bara Banki, Marwa.	
Unao, soft white	Sample not correct.
Partabgarh, Daudi	Ditto.
Fatehpur, soft white	Ditto.
„ Muria.	
Foam Banda, Ujaria.	
Banda, Pissi gangajali.	
Bijnor, Mundia	Medium hard.
Soft white, bran light straw colour.	
Cawnpore.	
From Banda, Ujaria.	
„ Pissia white.	
Kheri, Seta.	
Orai, Pissia white.	
From Sultanpur, Mundia.	
Meerut, Muriya.	
Soft white, bran reddish brown.	
Orai, Pissia (red).	
From Sultanpur, Mundia.	
Soft red, bran light straw colour.	
From Saharanpur, Munda.	
(d) Spikes reddish brown downy.	
Hard white, bran light straw colour.	
Saharanpur, Muria	
From Saharanpur, Munda.	

SECTION III.—BEARDED (AWANS SHORT).

Spikes short, yellowish, glabrous, glumes roundish, awns short, 1″ long, grain short plump roundish.	
Hard white, bran bright transparent.	
Partabgarh, Mundia.	
Bijnor, Dhania or misri.	

*Fresh sample is being procured as present one is apparently incorrect according to name.

SECTION IV.—BEARDED (AWNS LONG).

Wheat.	Remarks.
Spikes dense glabrous outerglumes sharply keeled awns 4″ to 7½″ long distinctly spreading when head ripens.	
(a) Spikes light straw coloured.	
Banda, Kathia.	Always contain a few soft grains with bran pale brown or grains showing soft spots.
Orai, Kathia.	
(b) Spikes reddish brown, Hard red bran dull reddish brown.	
Jalaun, Kathia.	
Orai, Kathia.	
Section V (a).—Bearded (awns long).	
Spikes long, squarish, very dense and pilose white with purplish tinge, outer glumes keeled to the base. Awns 4″ to 6½″ long.	
Hard wheat, grain long red.	
Bulandshahr, Barha.	
Bijnor, Sidhatordar.	
(b).—Bald.	
Bijnor, Mundia Sidha.	

Note—Glabrous not used in absolute sense, there being often a few sparse hairs on the rachis edges of glume etc.
Pilose=hairs long simple, but rather thickly than thinly sprinkled.
Light straw colour, used with some license in connection with bran.

Classification of juars.—During the last year that the provincial *juars* were grown for classification at the Cawnpore Station all plants were completely destroyed by floods.

Some of these I desired to resow for further study. In writing to the various districts to obtain seed 64 more juars turned up under new names. These have been sown this year on small plots. They are most likely only mere duplications, perhaps one or two new varieties may occur; but as far as I have worked there appear to be only two or three provincial species.

CHAPTER VI.

Amount and composition of drainage waters, rain, dew and canal water collected during the years 1903-04, 1904-05, 1905-06.

In 1902 it was decided, in consultation with the Inspector-General of Agriculture and Agricultural Chemist, to construct a rain-gauge and drain-gauges similar to those at Rothamstead. To these has been added since the collection and analyses of dew and canal water.

The analyses have been carried out by Dr. Leather, Imperial Agricultural Chemist, a proportionate sample of the daily collections being sent fortnightly to him. The drain gauges, four in number, were designed by me and constructed directly under my supervision in 1903. They consist of adjacent blocks of soil which have been underpinned and enclosed in masonry walls without disturbing the block of earth itself. They have each an area of $6' \times 7{\cdot}26' = 1/1000$ acre, surrounded by coping stones so as to retain the rain falling on their surface. Two of the gauges have a soil depth of 3′, the other two of 6′. Under each gauge is a reservoir to collect the water percolating. Hence in principle they follow the Rothamostead plan, differing somewhat in detail of constructoin not necessary to mention here. The site of the gauges had been manured and cropped regularly for many years according to the data available in the experimental station records and lies in an area of good natural fertility.

The rain water for analysis shown in statement No. I was caught on a funnel shaped galvanized iron gauge of exactly the same size as the drain gauges *i. e.*, 1/1000 acre. This was connected beneath with a cistern and protected above by a cover when not raining from the droppings of birds. This gauge was afterwards used for collecting dew, for this purpose except perhaps as a preliminary trial it was hardly suitable as the sides were not steep enough or smooth enough and a good deal of moisture remained standing on the surface; although this is a circumstance likely to occur to some extent in any case and difficult to avoid.

The object of these collections and analyses have in the case of the rains, dew and canal water, been to ascertain how far they can be looked upon as sources of fertility to the soil. Thus it has been supposed that the lasting fertility of Indian soils receiving little manure might in part be attributed to rain in this country containing larger quantities of fertilizing material than in Europe, but comparative analyses show that no such conclusions can be drawn.

With regard to the drain gauges the object is to form some opinion as to :—

(i) the amount of water that passes away in drainage when the land is uncropped,

(ii) the amount of water that passes away in drainage when the land is cropped,

(iii) some idea of the amount of evaporation which takes place on bare fallow calculated from the difference in rainfall and percolation under conditions No. 1,

(iv) the amount of nitrates and ammonia which are washed out of the soil by drainage when the land is respectively cropped or uncropped.

Up to the present time no crops have been sown on the gauges in order at first to obtain comparative records of the drainage when all are treated exactly alike. When sufficient information on this point has been obtained one 6′ and one 3′ gauge will be cropped, while between each pair of gauges a similar area will be likewise sown. In this manner it is hoped that considerable information will be gained as to—(1) the effect of a growing crop drainage and loss of nitrates and ammonia and (2) whether the large amount of nitrogen shown in the drainage water is unnatural and has in the case of the gauges so depleted the soil as to make a marked difference in the appearance of the crops and outturns, compared with simlar adjoing but only bunded areas.

It would take too long to review here fully the *pros* and *cons* as to the possible accuracy or inaccuracy of these drain-gauges. The principal objection put forward to such gauges has been the cutting off of capillary action from the surrounding soil, but another point equally important is the free escape of air from below which is likely to allow of a more rapid percolation and hence the washing out possibly of a larger amount of salts. From the notes I have made the rain appears to sink into the ground no faster in the gauges than in adjoining bunded land.* But this is not unlikely as superficially the air would escape upward equally easily in both cases and does not affect the possibility of the rate of percolation being different afterwards, when the resistance offered by air under pressure come more into force in one case and possibly less so in the other. Further there is the chance of nitrification taking place in the soil below owing to the admittance of air.

It is evident that the question of obtaining accurate information as to the movements of soil, moisture and salts presents great difficulties, for in any effort to solve it the conditions are liable to become somewhat artificial. How far this affects the case can only be ascertained by the study of collateral evidence.

In reading these drainage results it should be borne in mind that the surface of the gauges have been kept bare of vegetation and constantly hoed and that the drainage figures represent maximum conditions.

A glance at the percolation figures show the general small percentage of ammonia to nitrates but to this there are one or two exceptions when the proportion of nitrates and ammonia are similar, or the nitrates greatly exceed the ammonia. In this respect resembling dew, and I am of opinion that these figures probably only represent or partially so small quantities of moisture condensed during the night from

**Note.*—Rate of surface soakage does not appear equal or even constant on the gauges on somewhat scanty evidence the same appears to be the case for adjoining bunded fields, tread alike.

the air in the cistern. Thus, the quantities are not greater than have been collected as dew. The moisture is evident on the sides of the cistern in the morning and in the cold weather especially towards the outside. If the door of the cistern is left open at such times no moisture is obtained. Lastly in 1905 I obtained similar amounts of moisture in June (not shown in statement) before any rain fell but immediately prior to the break of the monsoon, when the air was charged with moisture. These amounts are so small that they do not materially affect the results and will still less so now the determinations of ammonia have ceased.

The percolations of Gauge No. 2 are not recorded in 1904-05, on account of a badly constructed and leaky cistern. For 1905-06 a fresh one was made but only after endless trouble and delay (the only capable *mistri* not being available) as a result of which the gauge so dried out from being open that it absorbed the whole rainfall for the season some 17″ without any percolation. Whereas leaving out of account what I have considered to be condensation of moisture in the cistern, for instance, figures for second fortnight of June 1904-05, it has in the last two years taken about 7″ in each case to start percolation in the other gauges. Finally in considering the difference between the 5″ and $\frac{1}{1,000}$ acre rain-gauges I attribute from personal observation the lesser quantity in the case of the larger gauge to be due to some extent to the rain splashing over the edge during heavy downpours in this country. The gauge, however, served its purpose of collecting sufficient quantities of rain for analyses during the course of a year.

STATEMENT No. 1.

Showing the quantity and composition of rain water at the Government Agricultural Station, Cawnpore, 1904-05.

Period.			Rainfall in inches: 5″ funnel gauge.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen Lbs. per acre.
				Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs per acre.	
June	1 to 15	...	·26	·148	·009	·050	·003	·012
„	16 to 30	...	3·77	·247	·211	·067	·058	·269
July	1 to 15	...	15·67	·230	·296	·080	·104	·400
„	16 to 31	...	1·13	·240	·606	·082	·208	·814
August	1 to 15	...	6·74	·200	·306	·059	·091	·397
„	16 to 31	...	4·79	·210	·228	·120	·130	·358
September	1 to 15	...	10·77	·080	·191	...	...	·191
„	16 to 30	...	·250	·080	·045	*Nil*	*Nil*	·045
October	1 to 15	...	*Nil*	...	...	...	...	...
„	16 to 31	...	·03	·550	·004	·470	·003	·007
November	1 to 15	...	·41	·910	·084	·384	·035	·119
„	16 to 30	...	*Nil*	...	...	...	...	...
December	1 to 15	...	·30	1·02	·069	·220	·015	·084
„	16 to 31	...	·68	·044	·007	·210	·033	·040
January	1 to 15	...	·26	1·240	·073	1·100	·006	·079
„	16 to 31	...	·26	Not analysed.				
February	1 to 15	...	·07	1·040	·026	·839	·021	·047
„	16 to 28	...	1·27	·830	·256	·178	·055	·311
March	1 to 15	...	·20	·780	·028	...	...	·028
„	16 to 31	...	·05	Appeard contaminated.				
April	1 to 15	...	*Nil*	...	...	...	...	...
„	16 to 30	...	*Nil*	...	...	...	...	..
May	1 to 15	...	*Nil*	...	...	...	...	...
„	16 to 31	...	·04	·57	...	*Nil*	*Nil*	...
	Total	...	49·20	·50	2·439	·30	·762	3·201

STATEMENT No. 2.—*Showing the quantity and composition of drainage waters at the*

Period.				No. 1. 6 feet gauge. (uncropped).						
				Rainfall in inches 5″ gauge.	Percolation in inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen Lbs. per acre.
						Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs. per acre.	
June	1 to 15	...	...	·26	No percolation.					
„	16 to 30	...	...	3·77	·004	1·72	·0017	·14	·00014	·0018
July	1 to 15	...	...	5·67	1·60	·31	·113	13·44	4·87	4·99
„	16 to 31	...	...	11·13	2·86	·02	·013	27·82	18·05	18·06
August	1 to 15	...	...	6·74	5·88	·02	·027	29·84	39·81	39 84
„	16 to 31	...	...	4·79	4·04	·01	·013	24·20	22·19	22·20
September	1 to 15	...	...	10·77	5·45	·10	·124	14·32	17·72	17·84
„	16 to 30	...	...	2·50	1·71	·02	·008	9·58	3·72	3·73
October	1 to 15	...	...	nil	·10	·03	·001	3·92	·09	·09
„	16 to 31	...	...	·03	·016	·04	·0001	3·12	·01	·01
November	1 to 15	...	...	·41	·008	1·02	·002	·42	·0007	·002
„	16 to 30	...	...	nil	·016	1·7	·006	·38	·001	·007
December	1 to 15	...	...	·30	·016	·84	·003	·72	·003	·006
„	16 to 31	...	...	·68	·016	·6	·002	.14	·0005	·0025
January	1 to 15	...	...	·26	·017	·08	·0003	nil	nil	·0003
„	16 to 31	...	...	·26	·014	·08	·0003	...	...	·0003
February	1 to 15	...	...	·07	·017	·06	·0002	·14	·0005	·0007
„	16 to 28	...	...	1·27	No percolation.					
March	1 to 31	...	...	·25	Not sufficient for analysis.					
April	16 to 30	...	...	...	·002	·07	·0000	2·34	·0011	·0011
„	1 to 30	...	...	...	Not sufficient for analysis.					
May	1 to 15	...	...	...	·0096	...	...	1·19	·0026	·0026
„	16 to 31	...	...	·04	·0084	·03	·0000	·967	·0018	·0018
		Total	...	49·20	21·7840	·38	·3146	7·80	106·47134	106·7861

STATEMENT No. 2.—*Showing the quantity and composition of drainage waters at the*

Period.				No. 1 6 feet gauge (uncropped).						
				Rainfall in inches 5″ gauge.	Percolation in inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen lbs. per acre.
						Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs. per acre.	
June	1 to 15	...	...	...	...	...	...	...	...	...
„	16 to 30	...	...	...	...	...	...	...	...	...
July	1 to 15	...	...	5·62	...	...	...	...	...	...
„	16 to 31	...	...	2·52	·5612	Not determined.		8·6	1·09	1·09
August	1 to 15	...	...	·29	·055	...	...	5·373	·067	·067
„	16 to 31	...	...	4·34	·8011	Not determined.		10·90	1·981	1·981
September	1 to 15	...	...	4 20	1·441	Not determined.		11·03	3·605	3·605
„	16 to 30	...	...	·10	·261	Not determined.		10·41	·6161	·6161
October	1 to 15	...	...	...	·0177	Not determined.		10·06	·0404	·0404
		Total	...	17·07	3·137	...	...	9·40	7·3995	7·3995

overnment Agricultural Station, Cawnpore, 1904-1905.

No. 3. 3 feet gauge. (uncropped).						No. 4. 3 feet gauge. (uncropped).						
ercolation inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen Lbs per acre.	Percolation in inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen lbs. per acre.	Remark
	Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs. per acre.			Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs. per acre.		
	No percolation.											No. 2 six feet gauge records not available.
·006	·62	·0007	·50	·0007	·0014							
1·39	·08	·026	21·98	6·81	6 84		under repair up to September 9th.					
3·78	·20	1·71	23·54	20·19	20 36							
5·34	·01	·012	10·43	12·63	12·64							
3·81	·10	·086	7·58	6·56	6·64							
3·49	nil	nil	5·96	8·78	8·78	6·55	·22	·32	5·73	8·52	8·84	
1·67	·02	·007	4·56	1·73	1·73	1·70	·07	·027	6·08	2·347	2·374	
	Percolation not sufficient for analysis.						Percolation not sufficient for analysis.					
·002	·04	nil	2·55	·001	·001	·004	·26	·0002	1·41	·0013	·0015	
	Percolation not sufficient for analysis.					·0065	·40	·00058	·53	·00078	·0013	
·011	·44	·001	·38	·0009	·002	·008	1·04	·0019	·45	·0008	·003	
·009	·18	·0003	1·36	·0027	·003	·0076	·6	·001	·87	·001	·002	
·010	·40	·0009	·51	·0011	·002	·0086	·4	·0008	·13	·0003	·001	
·0064	·60	·00087	...	...	·00087	·0075	·38	·0006	...	...	·0006	
·00515	·06	·00007	...	...	·00007	·0076	·2	·00034	·43	·0007	·00104	
·0069	·138	·0002	...	...	·0002	·0089	·18	·0003	...	...	·0003	
	No percolation. Not sufficient for analysis.						No percolation. Not sufficient for analysis.					
...	...	...	...	...	...	...	...	...	...	...	...	
·006	·066	·00009	·92	·0012	·0013	·006	·066	·00009	1·05	·0014	·0015	
·0123	·06	·0001	·34	·0009	·0010	·0124	·03	...	·25	·0007	·0007	
·0136	·03	...	...	...	...	·0145	·05	·0001	...	...	·0001	
2 56335	·19	·30623	6·2	56 7085	57·00284	8·3416	·30	·35291	1·70	10·87398	11·22704	

overnment Agricultural Station, Cawnpore, 1905-1906.

No. 3 3 feet gauge. (uncropped.)						No. 4. 3 feet gauge (uncropped.)						
ercolation in inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen. Lbs. per acre.	Percolation in inches.	Nitrogen as ammonia.		Nitrogen as nitrates.		Total nitrogen Lbs. per acre.	Remark
	Pts. per. 1,000,000	Lbs. per. acre.	Pts. per. 1,000,000	Lbs. per. acre.			Pts. per 1,000,000.	Lbs. per acre.	Pts. per 1,000,000.	Lbs. per acre.		
...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	·0554	Not determined.		14·08	·18	·18	
.4045	Not determined.		11·17	1·03	1·03	·5411	Not determined.		17·61	2·16	2·16	
...	...	...	...	...	...	...	...	...	...	...	...	
·9008	Not determined.		22·91	4·682	4·682	1·383	Not determined.		29·51	9·259	9·259	
1·612	Not determined.		33·08	12·10	12·12	1·582	Not determined.		33·49	12·02	12·02	
·0087	Not determined.		19·77	·0390	·0390	·0089	Not determined.		18·10	·0366	·0366	
	No percolation.						No percolation.					
2·926	...	...	21·73	17·851	17·851	3·5704	...	...	22·56	23·6556	23·6556	

That rather, on the other hand, leguminous plants grow freely everywhere.

That satisfactory results have only been obtained in localities which are deficient in tubercle-forming germs.

That soil inoculation is not a new thing, the custom of transferring soil from an old field to one which had not grown the legumious crop for many years having long been a practice in some places, and that there is no difficulty in doing so in this country if any occasion requires it.

That nothing more has ever been claimed by Dr. Moore for his method than convenience in transit and utility for those localities which are deficient in tubercle-forming germs.

The following statement shows the outturn per acre of country gram with and without inoculation :—

Field No.	Plot No.	Crop.	Treatment.	Outturn per acre in lbs.		Remarks.
				Seed.	Straw.	
42	1	Country gram.	Uninoculated	1,813	1,645	
„	2	„	Inoculated (mixture sprinkled on the field 10 litres).	2,077	1,710	
„	3	„	Uninoculated seed (ashes of 180 mds. of cowdung applied).	1,742	1,794	Germination not so good.
„	4	„	Inoculated seed and soil ...	1,951	2,276	
„	5	„	Uninoculated seed	2,074	2,028	
„	6	„	Inoculated seed	2,328	2,433	
„	7	„	Uninoculated seed	2,030	1,890	
„	8	„	Inoculated seed	2,088	2,169	
„	9	„	Uninoculated seed	2,059	3,062	
„	10	„	Inoculated seed only ...	2,475	2,237	
„	11	„	Uninoculated seed	1,537	1,885	Germination not so good.
„	12	„	Inoculated seed only ...	641	553	Damaged.

Study of provincial rotations.—This experiment is not a set of rotations designed directly to determine more suitable methods than those now in practice, but is rather arranged for the study of these practices and of more accurately forming some opinion of the effect they have on the fertility of the soil.

A.—Two-year rotation.

Two plots.—Wheat and gram in alternate years.
Two plots.—Wheat and *juar*+*arhar* in alternate years.
One plot.—Wheat and *juar*+*urd*+*lobia* „ „
Two plots.—Wheat and *juar* in alternate years.
One plot.—Wheat+*sarson* every year.
One plot.—Wheat+gram „ „
Two plots.—Wheat „ „

B.—Dofasli rotation.

One plot.—Wheat after *hemp* removed for fibre.
One plot.—Wheat after *urd* removed for fodder.
One plot.—Wheat after *guar* removed for fodder.
One plot.—Maize (country) followed by wheat in the same year.

Details of cultivation.—For the kharif crops (*juar, urd, lobia,* hemp and *guar*) the plots were ploughed twice and levelled after each operation. Seed was sown broadcast at the beginning of July and covered in with the Planet Jr. Cultivator, except in the case of maize (local variety) which was dibbled in 1 foot apart in the row and 2 feet from row to row.

For the rabi the plots were ploughed four times, cultivated once and levelled five times. The seed was sown behind the country plough on 22nd October 1905. All plots were irrigated three times, except plot nos. 14 and 15 which required water four times.

The outturns are given in the following tables:—

Previous cropping of these plots for two years				*Rotation experiment outturn in pounds per acre.*							
Field No.	Crop.	1902-1903.	1903-1904.	Field No.	Area.	Treatment.	Crop.	1904-1905. Kharif.	1904-1905. Rabi.	1905-1906. Kharif.	1905-1906. Rabi.
						(a) Two-year rotation.					
1	Wheat ...	3,546	...	1	1/6th acre,	Wheat and gram ...	Wheat ..	...	639	...	...
	Gram ...	...	1,878				Gram ...	...	243½	...	1,461
2	Gram ...	1,485	...	2	„	Gram and wheat ...	Gram ...	...	1,752	...	...
	Wheat ...	...	2,754				Wheat ...	...	...	...	1,059
3	Juar ...	387	...	3	„	Juar, arhar and Wheat ...	Juar ...	...	...	678	...
	Arhar ...	606	...				Arhar ...	...	...	972	...
	Wheat ...	...	2,282				Wheat ...	...	639	...	...
4	Wheat ...	2,562	...	4	„	Wheat and Juar +arhar.	Wheat ...	...	...	...	‡
	Juar ...	...	608				Juar ...	390	...	...	...
	Arhar ...	...	1,086				Arhar ...	...	Frozen...	...	...
5	Wheat ...	2,733	1,602	5	„	Wheat and juar + Urd + Lobia.	Wheat ...	...	...	...	1,380
							Juar ...	426	...	...	...
							Urd ...	36	...	...	...
							Lobia ...	...	...	...	...
6	Wheat ...	...	...	6	722 sqr. yards.	Wheat every year...	Wheat ...	...	1,200	...	1,330
7	Hemp ...	...	...	7	1/6th acre,	Juar and wheat ...	Juar ...	873	...	...	...
	Wheat ...	2,259	1,479				Wheat ...	...	...	...	1,239
8	Wheat ...	1,692	1,338	8	„	Wheat and juar ...	Wheat,	...	357	...	...
	Urd ...	8,400	11,088				Juar ...	...	...	639	...
							Wheat...	...	1,075	...	840
+† 9 and 10	Mustard	411	153	9	1/7th acre,	Wheat every year...	Wheat ...	...	1,061	...	835
	Wheat ...	1,949	1,806	10	1/7th „	Wheat + mustard	Mustard ...	...	Frozen	...	54
11	Wheat ...	..	2,232	11	1/6th acre,	Wheat + gram ...	Wheat ...	...	951	...	697
	Juar ...	390	...				Gram ...	...	Mixture	...	384
	Urd ...	30	...								
	Lobia ...	12	...								
						(b)—Dofasli rotation.					
12	Wheat ...	...	1,755	12	1/6th acre,	Hemp fibre—wheat	Fibre ...	336	...	546	...
							Wheat ...	...	797	...	762
13	Juar ...	402	...	13	„	Juar fodder—wheat	Fodder,	*	...	..	...
	Wheat ...	...	1,647				Wheat ...	...	578	...	1,386
14	Juar ...	...	560	14	„	Urd fodder—wheat	Fodder,	*	...	...	...
	Wheat ...	2,076	...				Wheat ...	...	837	...	1,462
15	Maize ...	...	1,358	15	„	Maize—wheat ...	Maize ...	537	...	866	...
	Wheat ...	2,205	1,080				Wheat ...	...	405	...	1,305

NOTE.—Sign + = ... Mixture.
„ − = ... Dofasli.
„ and = ... Alternate.

* Destroyed by flooding.
† This plot originally one, was divided into two plots:—No. 9 wheat and No. 10 wheat+mustard.
‡ Not recorded owing to some mistake having occurred.

In 1904-1905 low outturns indicate the effects of frost.
In 1905-1906, the outturns were affected to some extent by poor germination on account of deficient moisture.

CHAPTER VII.

ENTOMOLOGICAL NOTES.

1.—*Pod borer on gram.*

Heliothis armigera Hübn figure in Indian Museum Notes, Volume I, No. 2, plate VI, figure IV. The larva of this moth is known in this province as *Bahadurà* or *Chhedà* and in America as the "boll worm," as in that country it attacks the cotton bolls as well as other crops. In this country (at least in this province), curiously, but fortunately, it seems to confine its attacks to other crops,* eating into the pods of gram and *arhar*, and is also recorded as boring into the capsules of poppy and pods of peas. The principal crop which it injures in this province as far as my observation goes is gram. Every year it does a great deal of damage, and in some years the amount must be enormous. It is generally and popularly reported as appearing about the time the gram pods form. At this time the plant is fully grown and lies in a close mass; thus the insect is not only hidden partly in the pod (occasionally actually inside) but the pods are themselves situated more or less so as to be concealed. Hence the hopelessness of attacking the insect at this stage in any way becomes apparent. It was for this reason and the great amount of damage which it perpetrates that while making a general study of the insects of the province I commenced observations into the life history of Heliothis armigera in order to ascertain if it occurred on gram or other plants at any other time during which remedial measures might be more readily applied. The results of these observations have gone to show that the time generally mentioned as the period of its appearance only indicates the greatest intensity of its attack, and that continued search has shown that the real commencement of the appearance of the pest on gram lies much nearer the commencement of its growth, *i.e.*, about the beginning of December. This point is important in the fact that at this stage the plants do not lie close together in a mass to prevent the application of any insecticide taking effect, and that as the pods are not formed the insect obtains its substance by eating the epidermis of the leaves. Moreover as the larvæ do not appear in any great numbers until after the period when gram is usually picked by villagers for "sag;" this admits of any poisonous application to be applied to the leaves and thus to the food of the pest, without any danger to human life. In any other country a discovery of this description might have far reaching effects. But in India we have yet to discover how crops, which cover large extent of country and which are grown by individual poor cultivators on small areas, can have their insect pest effectually dealt with.

2.—*Red larva on wheat.*

Cecidomyia. sp.—The imago or "midge" is closely allied to the mosquito, and its larva is found in considerable numbers on wheat. They are very small, only $\frac{1}{12}$th of an inch long, of a reddish colour, pointed at both ends, legless, blind, and have only a sucking mouth by which they extract the juices of the plant. When about to pupate (observations made indoors) they descend into the soil provided the soil is kept quite moist, forming a small cave-like pupa case in the earth and closing the opening at the last with a network of threads. In the case in point they pupated on the 10th of April and the "midges" came out on the 14th and 15th. Shortly before the escape of the "midges" the pupæ emerge from their earth case projecting about three quarters their length. The further life history has not been observed except that it has been noticed that a similar insect, possibly the same but not as yet compared, occurs on *kondon*. The chief interest in this insect lies in its connection with rust. A hundred years ago or more before the powers of the microscope had revealed its real nature, this disease was sometimes attributed to the larva of a similar small insect *Cecidomyia tritici* and the reddish pustules of rust were in common opinion supposed to be its fæces. It was curious to note, about five years ago when I was first making enquiries as to rust in this country that an exactly similar opinion was held by some cultivators in regard to the larva of the insect under consideration. Owing to this insect wriggling about on the leaves, often covered with uredospores and being most evident when rust is at the height of its attack, I was led into an attempt to trace

* The Indian boll worms (add) are quite different insects.

out some of its life history in order to ascertain if in some way it had any connection with the carrying of rust over from one season to another. But so far I can trace no evidence of such being the case, or any microscopic signs of the spores passing through the body, a fact perhaps hardly likely, considering the nature and size of the larva's mouth.

CHAPTER VIII.

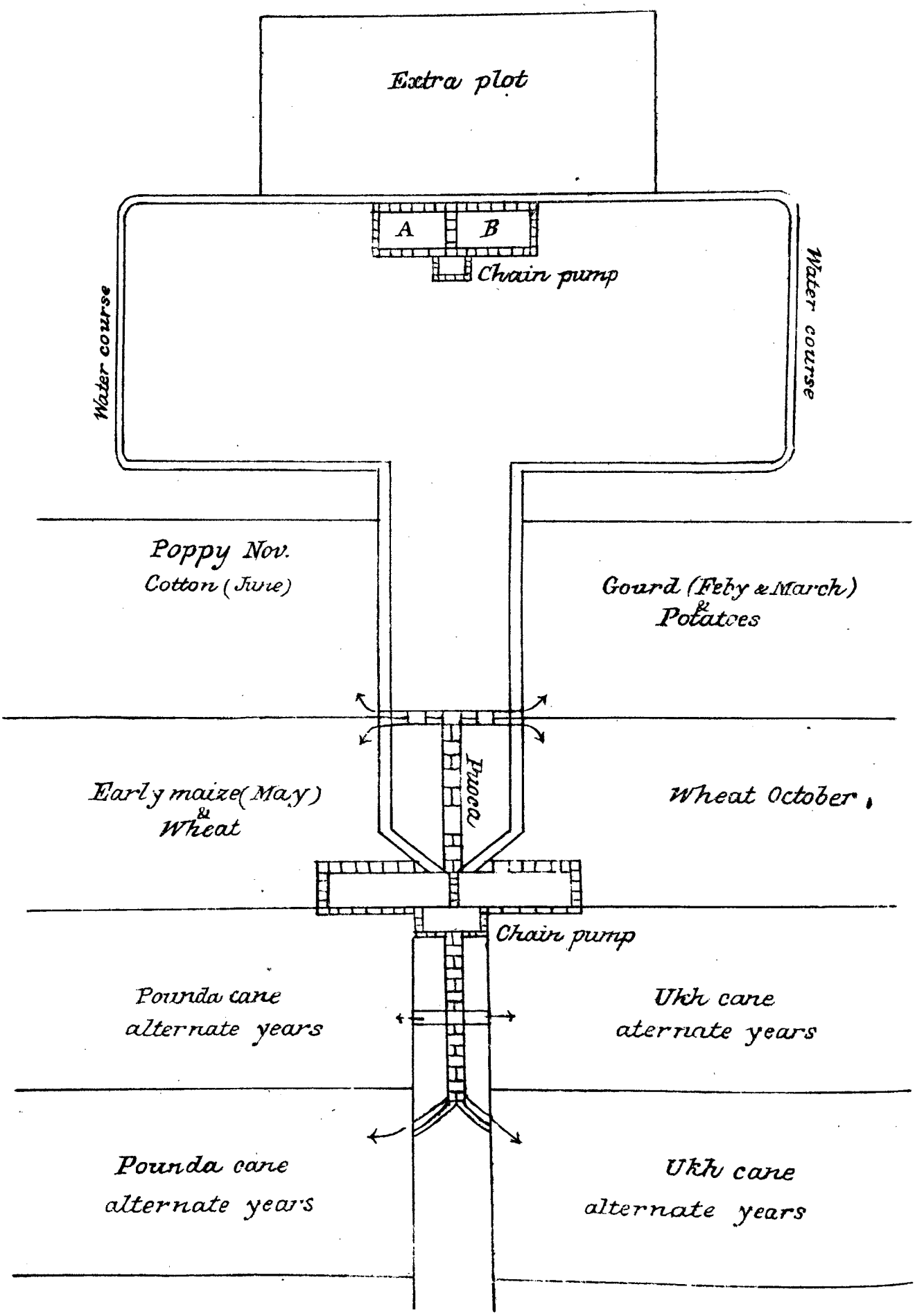
Miscellaneous Experiments.

Irrigation and seepage experiment.—This experiment is being carried out in accordance with the recommendations of the Irrigation Commission.

On the first hand the object of enquiry is to ascertain the amount of water necessary for the ordinary irrigated crops of the province. In the second to ascertain how much water is lost in the form of seepage in the ordinary field water channel at different times of the year.

Beyond stating that they would not accept any form of metre measurement, the Irrigation Department have not specified the manner in which they wished for such trials to be carried out. There is little difficulty in measuring the actual amount of water given to a crop ; but when it comes to a question of measuring seepage, the matter is very considerably complicated. In the first instance, it is necessary to have two sets of tanks, one for measuring the water raised, the second for again measuring the water at the other end of the channel immediately before it is applied to the crop and the difficulty arises here, for it stands to reason that two such different crops as sugarcane and cotton require very different land, while to dot a farm over with pucca tanks would be extremely unsightly and expensive. Consequently it has taken some time before it was possible to hit on a suitable plan and to fix on a suitable site which would command with two sets of tanks all the requirements as to soil &c., for the different crops. Hence so far the measurement has been confined to the direct application of water but by the following cold weather all necessary arrangements for the measurements of the seepage will be complete.

The following diagram and description illustrate how this is proposed to be accomplished and no pains have been omitted to make the results as detailed and accurate as possible. The water is first raised up alternately into the two cisterns A and B, each holding 250 c.ft. of water and measured mechanically. This prevents any mistake which might arise in merely keeping tally on paper. It then passes along the water channel to two other pucca cisterns C and D of equal capacity ; here it is again mechanically measured before being pumped on to the land. The fields are each of a quarter of an acre and are arranged round about the second pair of cisterns so that the water passes on to them by means of pucca channels without any further seepage ; at the same time a site has been fixed on by which fairly suitable land has been obtained for each crop. It will be noticed that there are two watercourses both being exactly of the same length, *i.e.* 150 yards long which has been taken as a fair average distance. The object of these two watercourses is to ascertain in one instance what is the seepage occurring in a channel regularly used from January and February up to the rains once or twice a week as for sugarcane, and on the other hand to ascertain the amount of seepage when a channel is used for the first time in May or June as for early maize or cotton.


Extra plot
A
B
Chain pump
Water course
Water course
Poppy Nov.
Cotton (June)
Gourd (Feby & March)
&
Potatoes
Early maize (May)
&
Wheat
Fuoca
Wheat October
Chain pump
Pounda cane
alternate years
Ukh cane
aternate years
Pounda cane
alternate years
Ukh cane
alternate years

Deep and shallow tillage.—The experiment was started in 1901 on the following scheme. There are three plots, the area of each being one-fourth of an acre, each plot receiving cowdung at 100 lbs. nitrogen per acre, provided the land does not become too high for wheat. The tillage operations are as follows :—

Plot No. I.—Sub-soiling once, 8″ to 9″ deep, followed by two ploughings with country plough.

Plot No. II.—Ploughing twice or thrice, (according to season) with Watts' plough, 5″ deep, followed by two ploughings with country plough.

Plot No. III.—Eight ploughings with country plough. Seed was sown with country plough and the land levelled with the *patah*. Owing to deficient rain Plot No. III only received six ploughings with country plough. Compost manure was applied to each plot at 100 lbs. nitrogen per acre.

The outturns obtained are given in the following table :—

Acreage outturn of wheat on plots ploughed in three different ways.

Year.	Plot No. 1 sub-soiler and country plough.	Plot No. 2 Watts' and country plough.	Plot No. 3 country plough.	Remarks.
1901	960	813	779	
1902	1,692	1,756	1,455	
1903	1,582	1,530	1,617	
1904	2,090	1,900	2,058	
1905	948	904	712*	
1906 { Grain ...	2,434	2,360	222·6	
1906 { Straw ...	473 6	31·38	3,426	

* The following remarks were omitted last year on the result of the experiment :—

Constant rain in early part of season led to much grass and it was quite evident that under such conditions the work of the country plough is less effective.

Primary effect of deeper tillage on doab soils.—In continuance with last year's experiment the Watts' plough was again tried in comparison with the country plough on a fresh piece of land previously only ploughed with the latter. The land was divided into eight plots, each $\frac{1}{16}$th acre, which were treated as follows :—

(*a*) Watts' plough plots, ploughed three times and levelled three times.
(*b*) Country plough plots, ploughed five times and levelled four times.
Plots nos. 1 to 4 were manured with cow-dung at 100 mds. per acre.
Plots nos. 5 to 8 were unmanured.

The comparative outturns are given in the following table :—

No. of plot.	Treatment, country or Watts' plough.	Last year's outturn in lbs. per acre.	This year's outturn in lbs. per plot.	This year's outturn in lbs. per acre.	Remarks.
1	Watts' plough ...	1,560	113	1,808	No manure was applied to any plot last year.
2	Country „ ...	1,510	59¾	956	
3	Watts' „ ...	1,870	59¾	956	
4	Country „ ...	1,380	66½	1,064	
5	„ „ ...	1,030	70	1,120	
6	Watts' „ ...	980*	71	1,136	* Noted on in last year's report.
7	Country „ ...	1,060	76¼	1,220	
8	Watts' „ ...	1,340	82½	1,320	

Both this year and last the number of ploughings with country plough were restricted by the season, as many as eight ploughings being frequently given when possible. Thus in a favourable year the outturns from country plough plots might have been somewhat better. But there is nothing to show that any injurious effects follow the slightly deeper tillage of the Watts' plough in this vicinity when such ploughings are done during a period of fallow and sometime before the crop is sown.

The application of Bordeaux mixture to the potato crop.

This experiment was started in the year under report to ascertain how far its application affects the outturn of the potato crop.

Four plots were taken for this purpose, two of them were sprinkled with the mixture and two were left without any treatment; all the plots were otherwise treated alike. The outturn is given in the following table :—

Statement showing the acreage outturn of potato treated with Bordeaux mixture (copper sulphate mixture).

No. of plot.	Treatment.	Outturn per plot in lbs.	Outturn per acre in lbs.	Remarks.
1	Bordeaux mixture sprinkled ...	552½	8,840	Proportion of copper sulphate lime and water.
2	No treatment ...	558½	8,936	Copper sulphate=6lbs
3	Bordeaux mixture sprinkled ...	622	9,952	Lime=4lbs.
4	No treatment ...	558	8,928	Water=40 gallons.

N.B. – These plots had sugarcane crop with 250 lbs. nitrogen per acre in previous years.

Fodder crops for seasons of drought.

Endeavours are being made to find a suitable fodder crop or crops which can be sown with irrigation in September or with a heavy fall of rain coming at that time, in years when the failure of the rains during the previous part of the season has been so complete as to produce a fodder famine. As mentioned in last year's report, Burseem and many provincial varieties of juar were tried and proved useless for the purpose. In the year under report mixtures of oats, sarson and mustard and oats and mustard alone were sown. Oats either alone or mixed gave no promise of being of use sown at this period of the year, unless perhaps supplied with frequent irrigations.

Mustard grows sufficiently well at this time, but eaten alone is liable to produce scouring and some other crop requires to be found to sow with it. Owing to the conditions under which such fodder famine may arise it is almost necessary that seed should be able to be obtained without delay and hence must be Indian. Bombay juars, bajra and other crops are being further experimented with.

Reference to errors in outturn.

All experimental outturns of grain are weighed at once after threshing. They are again weighed as soon as cleaned to prevent any theft. Finally I check all weighments myself before sending to the godown. Nevertheless I regret to have to record one or two mistakes. But on the other hand, the death of the Farm Bailiff, the changes in staff and complete set of young and inexperienced men makes it excusable, though particularly disappointing in one case.

DATED CAWNPORE :
The 23rd of August 1906.

J. M. HAYMAN,
Deputy Director of Agriculture.

APPENDIX No. 1.

Character of the season.

The season was characterised again by lateness of the monsoon and consequent shortened season at Cawnpore. Early sowings were followed by sufficient rain to damage germination which was afterwards succeeded by an insufficiency extending to complete drought in many places.

Very little rain also fell in the rabi season and the wheat crop required several waterings, flushing in many cases also being necessary before sowing. When and where rain did fall to any extent it seems to have managed to do so just at the wrong time, *i.e.* just after sowing and when maize was flowering in the kharif. While in the rabi it was deferred until the gram was in flower and was in consequence in many places rather a doubtful boon.

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Hemendra Kothari

on 24 February, 2020

APPENDIX No. 1.—*Amount of rainfall at the Cawnpore agricultural station.*

Month.		1904-1905.		1905-1906.		Average rainfall of eight years in inches from 1891-99.
		Rainy days.	Rainfall in inches.	Rainy days.	Rainfall in inches.	
June	First half	1	·26	...	...	3·57
	Second half	3	3·77	...	...	
July	First half	9	5·67	9	5·62	9·60
	Second half	16	11·13	2	2·52	
August	First half	9	6·74	3	·29	13·61
	Second half	9	4·79	6	4·34	
September	First half	4	10·77	8	4·20	2·23
	Second half	2	2·50	1	·10	
October	First half	...	...	...	...	1·73
	Second half	1	·03	...	...	
November	First half	1	·41	...	...	·48
	Second half	...	...	...	...	
December	First half	1	·30	...	...	·27
	Second half	3	·68	1	·03	
January	First half	2	·26	...	...	·64
	Second half	2	·26	...	...	
February	First half	1	·07	4	·34	·50
	Second half	1	1·27	4	·94	
March	First half	4	·20	1	·03	·05
	Second half	1	·05	2	·77	
April	First half	...	...	...	...	...
	Second half	...	...	...	...	
May	First half	...	...	...	...	·33
	Second half	1	·04	...	...	

Note.—Days on which there is not less than ·01 inch of rain are counted as rainy days.

APPENDIX No. 2.—*Mean temperature at the Cawnpore agricultural station.*

Month.		Under shade.		In the open.		Remarks.
		Maximum.	Minimum.	Maximum.	Minimum.	
June	First half	108·5	82·16	117·1	86·3	
	Second half	109·1	83·7	116·4	87·6	
July	First half	94·13	76·6	102·3	80·7	
	Second half	93·9	76·46	101·96	81·18	
August	First half	91·6	77·6	100·4	84·4	
	Second half	94·53	75·5	102·34	93·81	
September	First half	91·36	76·6	102·73	82·93	
	Second half	92·46	72·56	109	76·53	
October	First half	97·2	63·9	117·23	67·03	
	Second half	94·	57·32	115·03	60·64	Average for 14 days.
November	First half	93·63	58·13	115·23	54·06	
	Second half	85·16	50·8	108·46	46·76	
December	First half	80·23	43·5	105·7	39·1	
	Second half	77·0	48·2	94·3	44·7	
January	First half	72·4	38·5	97·2	34·9	
	Second half	79·8	47·4	104·0	43·7	
February	First half	78·8	50·8	101·6	48·1	
	Second half	72·5	53·	92·8	49·0	
March	First half	82·2	57·2	104·9	49·6	
	Second half	89·6	61·0	106·97	55·5	
April	First half	103·1	68·56	113·6	56·53	
	Second half	107·13	70·9	115·86	65·33	
May	First half	112·9	79·53	120·56	75·13	
	Second half	114·	83·25	122·34	80·4	